METROTECH

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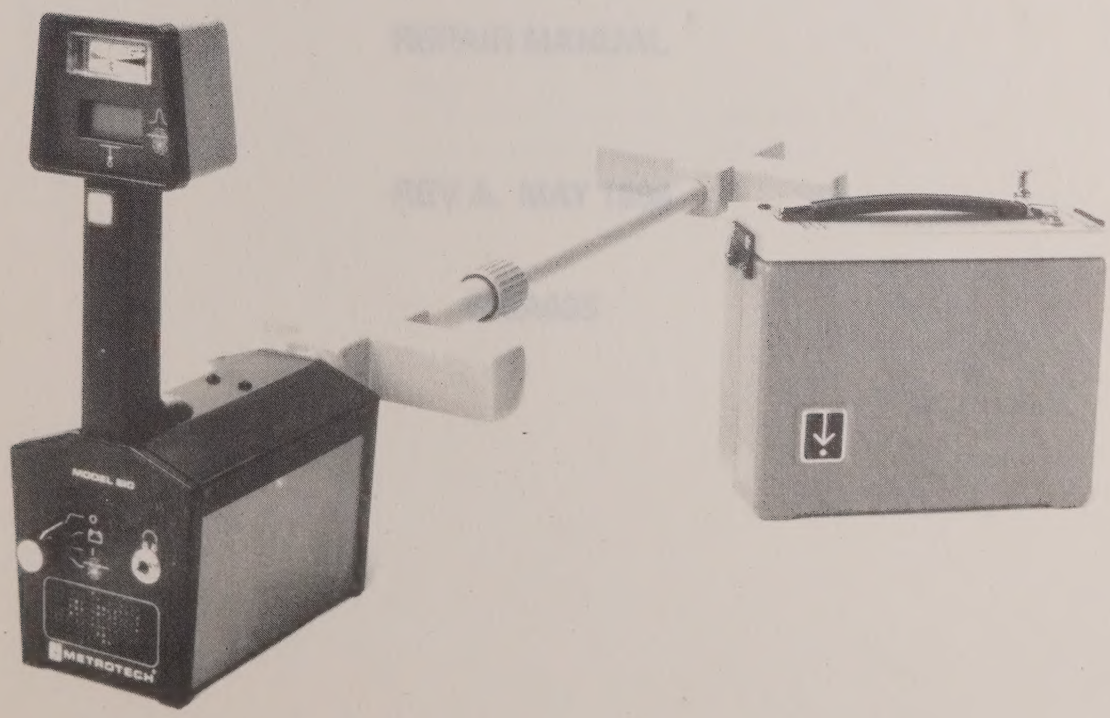
Model 810 Line Tracer Repair Manual



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FOREWORD

The format of this manual is intended to assist the repair technician in recognizing the symptom of a problem, diagnosing the problem, verifying the solution and calibrating to product specifications.

In order to recognize a problem, the technician must understand how the unit operates under normal situations. The first 5 sections of this manual are there to assist in this area. These sections are as follows:

PRODUCT SPECIFICATIONS

OPERATOR'S MANUAL

THEORY OF OPERATION

SUBASSEMBLY FUNCTIONS

ACCESSORIES

In addition, section 18 of this manual deals with the theory of underground pipe and cable locating. This may prove helpful in that most always, the actual cable locating and repair and calibration of locating equipment are worlds apart.

To assist in diagnosing any problems found,sections 6, 7 and 8 deal with verifying product performance to required specifications. In addition, section 9 deals with receiver toubleshooting and section 10 with transmitter troubleshooting.

After a problem has been diagnosed, it is necessary to calibrate the unit so that the proper results are obtained. sections 11 through 14 are the tuning and calibration procedures used to obtain desired readings. It is also important to point out that while calibrating the unit, subtle irregularities may be found which could cause a future problem.

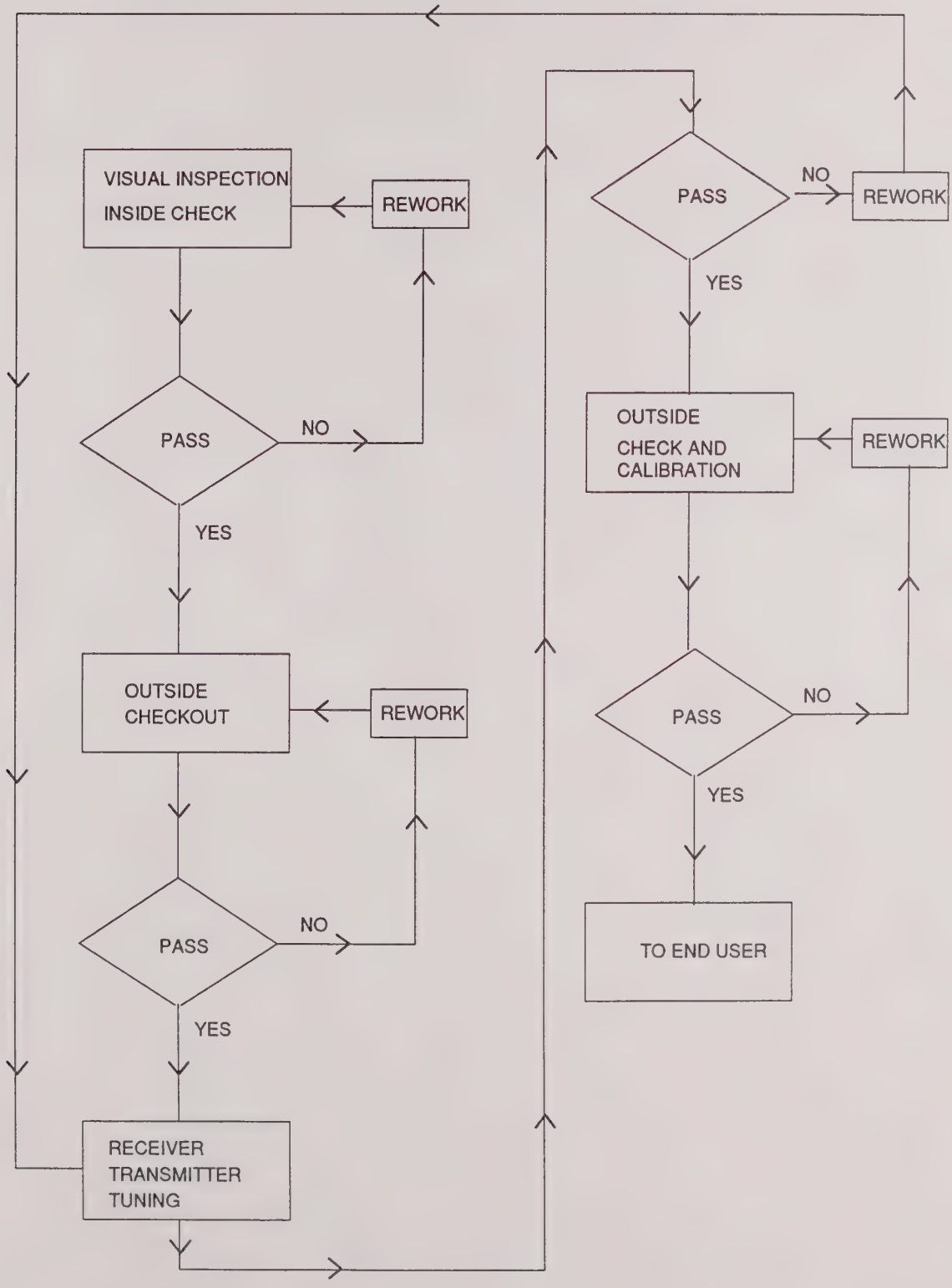
NOTE! *IT IS VERY IMPORTANT THAT ALL ASPECTS OF THE MODEL 810 ARE CHECKED FOR PROPER CALIBRATION TO PREVENT PROPERTY LOSS OR LOSS OF LIFE OR LIMB ON A MIS-LOCATE.*

The intent of the repair procedures called out in this manual are to identify and solve functional problems and calibrate functions to required specifications. This may involve replacing components in the receiver stem or motherboard or replacing individual modules or circuit boards. Troubleshooting to component level in all cases may not be feasible due to the test equipment and training that would have to be involved.

Voltages and wave forms shown on block diagrams in this manual are those which exist when the unit is set up per the tuning and calibration procedures.

The following repair steps should be followed to ensure proper operation upon returning to the field:

MODEL 810 REPAIR CHART



METROTECH®

810

The 810 Radio Frequency Line Tracer

- Accurate location of cables, or water and gas distribution systems where insulators may be present
- Inductive use for inaccessible tracing
- Visual and audible left/right guiding system
- Digital signal strength indicator
- Automatic Sensitivity Control, no manual adjustments
- Push Button Depth Indicator for instant depth readout

Radio Frequency Line Tracer

The 810 Line Tracer provides versatility for both direct and inductive tracing of pipes and cables with automatic features.

- Visual and audible left/right guiding system guides the operator toward the conductor path.
- Digital signal strength indicator, an easy-to-read, three-digit, liquid crystal display (LCD) allows the operator to pinpoint the target conductor.
- Push button depth indicator—with the push of a button the LCD indicates the depth of an underground pipe or cable.
- Single control switch activates the ON/OFF, BATT TEST, and OPERATE modes, eliminating multiple settings.
- Automatic sensitivity control eliminates the need for manual adjustments reducing human error factors.

The radio frequency (RF) 810 Line Tracer is an excellent instrument for tracing water and gas distribution lines, cables, inductive locating, and blind searching. The high frequency signal is able to jump insulators and rubber gaskets often found in water and gas distribution systems. Since the radio frequency travels easily through the ground, the 810 is an ideal instrument for inductive locating. The floodlight quality of the RF signal will induce signal onto conductors 8–10 ft. on either side of the transmitter making it an excellent instrument for blind searches.

The 810, operated from a standing position, features a left/right guidance system which directs the operator toward the conductor path. A simultaneous field strength display aids in pinpointing the conductor, and with the push of a button, the depth of the conductor appears on the LCD. The sensitivity is automatically controlled to compensate for changes in signal strength caused by changes in conductor depth and attenuation of signal over distance. This instrument is designed to minimize electrical interference.

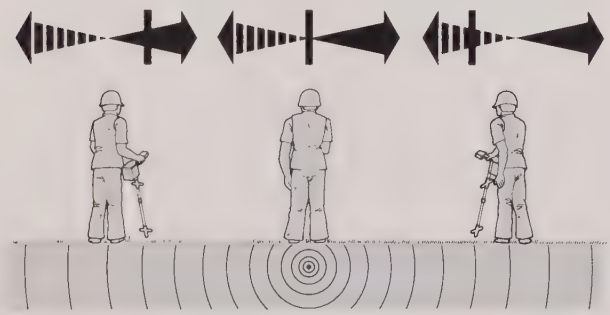
Because of the increasing density of underground utilities, the need for fast and accurate locating instruments has never been greater. The 810 RF Line Tracer offers advanced and automatic features to ensure the best possible identification and trace of continuous metallic pipe or cable.

Having positioned the transmitter and energized the target conductor (either inductively or conductively) the operator is ready to begin tracing. The receiver is held in front of the operator from a standing position.

The following features simplify the tracing operation:

Visual and Audible Left/Right Guidance System

Directs the operator to the conductor via the position of the directional needle and the presence or absence of a steady or pulsing tone. If the needle moves to the right (the tone will be steady), the operator should move to the right; if the needle moves to the left (the tone will be pulsing), the operator should move to the left; when the needle is centered and the tone is absent the operator is over the target.



Digital Signal Strength Indicator

The Digital Signal Strength Indicator also guides the operator toward the target conductor. The LCD displays the numerical value of the field strength in small increments which assists the operator with pinpointing the target (the highest value pinpoints the position of the conductor).

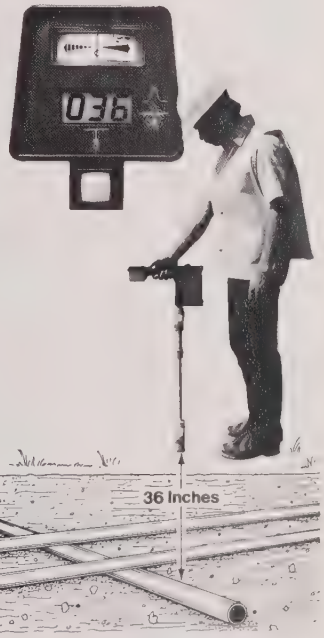
MOVE TO THE RIGHT | OVER CONDUCTOR | MOVE TO THE LEFT

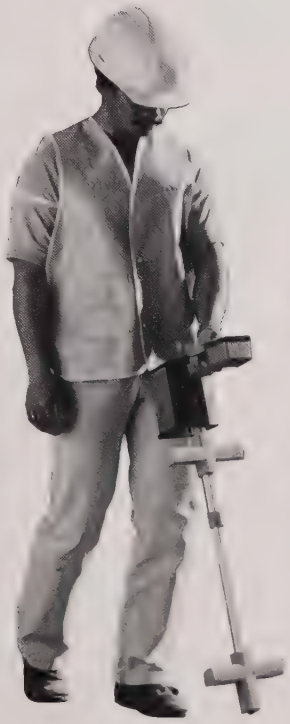
Automatic Sensitivity Control

Automatically compensates for changes in signal strength caused by changes in conductor depth and attenuation of signal over distance. No manual adjustments are needed. This instrument is also designed to minimize electrical interference.

Push Button Depth Indicator

With the instrument tip in a vertical position directly over the conductor, and a push of the depth button, the depth (in inches or centimeters) is displayed on the LCD.





Human Engineered

All tracing and depth determination is made from a standing position (no stooping, squatting, or angular measurements required). Light in weight, the receiver is balanced for natural, comfortable right or left hand use, reducing operator fatigue. All instrument readouts are in line-of-sight. A single control switch activates all functions.

For your locating needs—RF or AF?

Metrotech offers both—the 810 radio frequency instrument, and the 850 audio frequency instrument. The radio frequency of the 810 makes it an ideal instrument for tracing water and gas distribution systems where insulators may be present and for general inductive use. The audio frequency 850 is an excellent locator for long distance tracing and isolation of continuous conductors, such as cables, in congested areas. The 850 is one of the few audio frequency instruments available with inductive coupling capabilities, however, the 810 would be the instrument of choice if most of your locating is being done inductively. The following table shows which instrument is best suited for your application.

APPLICATION	810	850
Water	excellent	not rec.*
Gas		
Distribution	excellent	not rec.*
Transmisison	good	excellent
Power		
Direct	good	excellent
Inductive	excellent	good
Telephone		
Copper	good	excellent
Fiber Optic	good	excellent
CATV	good	excellent

APPLICATION	810	850
Pipeline	good	excellent
Blind Searching	good	not rec.
Traffic Control	good	excellent
Grounds Maintenance	excellent	good
Railroad Communications	good	excellent
Refineries	excellent	good
Military Bases		
Pipes	excellent	good
Cables	good	excellent

*not recommended if insulators are present

Technical Specifications – 810

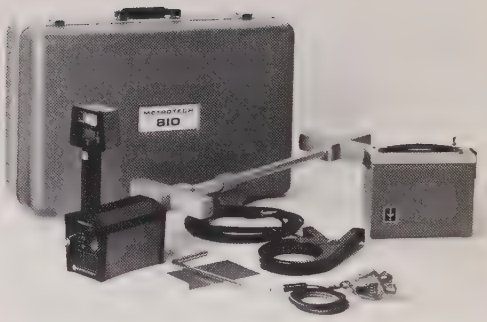
Transmitter

Nominal Output Power:	250 mW
Output Frequency:	83.0775 kHz ± .002%, Crystal controlled for interference resistance
Batteries:	6 NEDA 13F "D" cells, alkaline
Weight:	3.9 lbs (1.8 kg)
Dimensions:	8"L x 3¼"W x 6½"H (20.3 x 8.3 x 16.5 cm.)

Receiver

Trace Accuracy:	± 1 in. from 0 to 3 ft. (91 cm.); ± 3% over 3 ft. (91 cm) in depth
Depth Readout Accuracy:*	± 10% under normal conditions
Sensitivity Control:	Automatic, no adjustments
Depth Readout Range:	To 13 ft. (400 cm.)
Batteries:	4 NEDA 1604A alkaline (9V)
Battery Test:	Indicated on meter
Weight:	4.1 lbs. (1.9 kg.)
Dimensions (extended length):	32½"L x 7¼"W x 12¼"H (82.6 x 18.4 x 31.1 cm.)
Temperature Range:	0 to 110°F (– 18 to 43°C)
Shipping Weight (gross):	20 lbs. (clamp: add 2 lbs.) (9.1 kg [clamp: add .91 kg])
Shipping Dimensions:	24¼"L x 10⅜"W x 17¼"H (61.6 x 26.4 x 43.8 cm.)

* Actual performance may be affected by improper signal drive method, concentration of utilities, poor ground conditions such as highly conductive soil, or extremes of temperature. Signal variations in large pipes can also affect accuracy



Standard Equipment

The Metrotech Model 810 comes complete with transmitter, receiver, conductive attachments, batteries, operation manual, and padded carrying case.

Optional Accessories

4820 Metroclamp for use on conductors four inches (10 cm.) or less in diameter

Introductory Videocassette–17 minutes, VHS, ½ inch (P/N 600A029), ¾ inch (P/N 600A050)

Customer Service

User training, applications assistance, and servicing are available. Service centers are in Nashville, TN and Mountain View, CA.

Warranty

One year warranty on labor and material. Text available on request.

Ordering Information

For information or dealer referral, please contact Metrotech Corporation, Telephone: 415/940-4900. Fax: 415/962-9527. Telex: 6502726454MCI UW.

This product is covered by US 4387340, US 4520317, EPO 45486 and other US and Foreign Patents pending.

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810 SYSTEM THEORY OF OPERATION

The Model 810 Line Tracer consists of the receiver, transmitter, conductive attachment assembly and optional inductive coupler (4820 Metroclamp).

Transmitter Theory of Operation

The transmitter is coupled to the conductor to be traced by one of three methods: 1).Inductive-radiating a signal from the directional antenna located in the transmitter, 2).Conductive- signal is direct connected from the transmitter direct output jack to the conductor using the conductive attachment assembly, 3). Inductive Coupling-radiating a signal to the conductor by using the optional 4820 clamp which functions like a transformer.

The 810 transmitter contains 6 1.5 volt alkaline batteries (Neda 13f), battery condition - power output indicator, directional antenna, output coupling circuits for direct connection, 83.0775khz oscillator and power amplifier.

Battery Condition - Output Power Indicator

The power test lamp allows an AC neon lamp to glow indicating sufficient output power. This occurs when battery voltage is between 6-9 volts when the momentary power switch is depressed. The circuit consists of a tap from a coil through a capacitor to the lamp to ground. Output current should be received at the direct output jack.

Directional Inductive Antenna

A multiturn ferrite rod antenna is located in the bottom of the transmitter. **CAUTION**: *Do not operate the transmitter while it is resting on or near a metal surface or large metal object. This may detune the circuit, cause incorrect test results and cause permanent damage.*

83.0775khz Oscillator

The 83.0775khz oscillator sine wave is generated by dividing a 2.658400MHZ crystal sine wave by 32 into a square wave. The square wave is then filtered to produce a 83.0775KHZ sine wave. This signal is then fed to a power amplifier.

Output Coupling

When the conductive attachment is not plugged into the Direct Output Jack, the directional inductive antenna is connected to the output circuits via the output jack causing the transmitter to radiate the 83.0775KHZ signal. When the conductive attachment or the 4820 clamp is plugged into the Direct Output Jack, the inductive antenna is disconnected and the jack is connected to the circuits. If there is nothing plugged into the direct output jack, the transmitter is in the inductive mode and radiating a 83.0775KHZ signal through the ferrite loop antenna.

RECEIVER THEORY OF OPERATION

The Model 810 receiver is a tuned radio frequency receiver with 4 receiving sensors channeled through 2 amplifiers and processed for 3 modes of operation; 1). Signal Strength (AUX), 2). Left/Right Indication, and 3.) Depth.

Signal Strength (AUX) Mode Fig 1

The 83.0775KHZ signal from the conductor being traced enters the receiver through a parallel tuned circuit consisting of a sensor coil (reference) and capacitor precisely tuned to 83.0775KHZ. The signal is amplified by an operational amplifier on the Left/Right preamp circuit board located in the bottom antenna housing of the receiver. The signal is fed to a variable transformer tuned amplifier with automatic gain control (AGC). The signal is then rectified and filtered to a DC voltage proportional to the signal received.

The reference sensor and preamp can be switched off by plugging a 4820 clamp into the AUX Input Jack located on the receiver rear panel (battery access door). This is done for tracing or identifying pairs or remote sensing. This can also be used to determine if the reference sensor and amplifier are operating properly. The aux position of the receiver function switch, kills the left/right, depth and audio functions. In this mode, only signal strength is obtained.

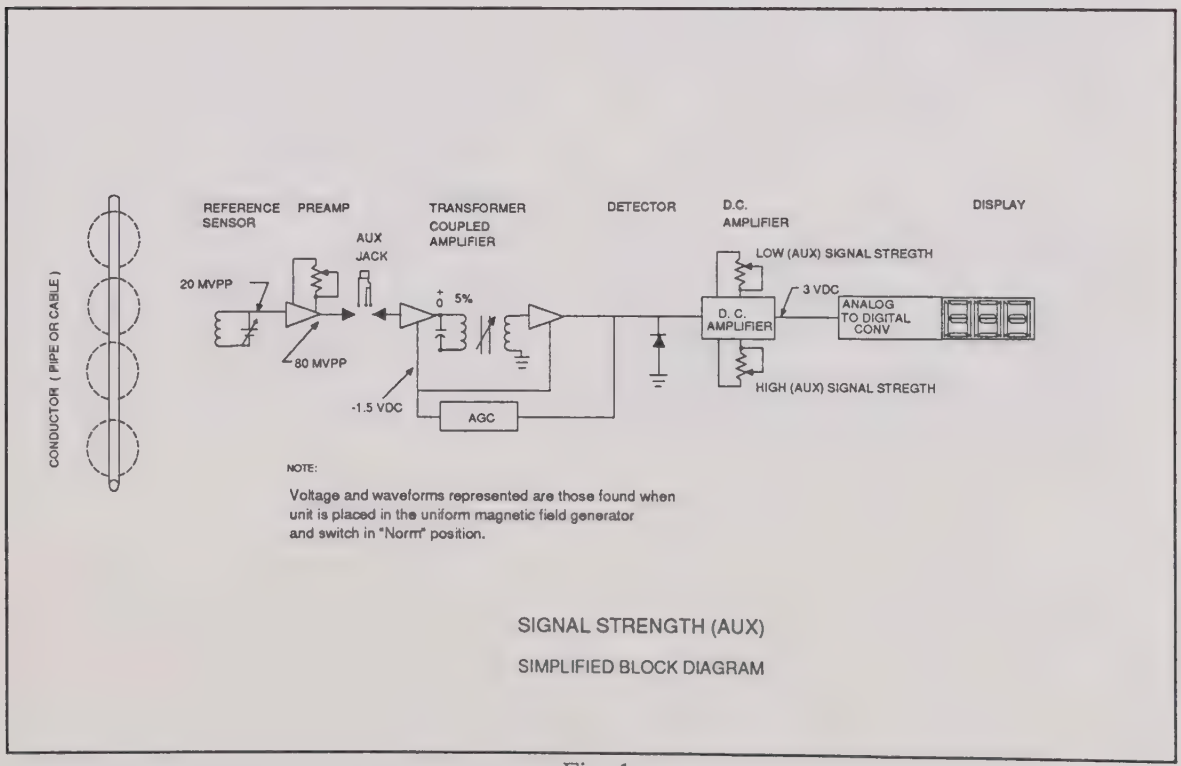
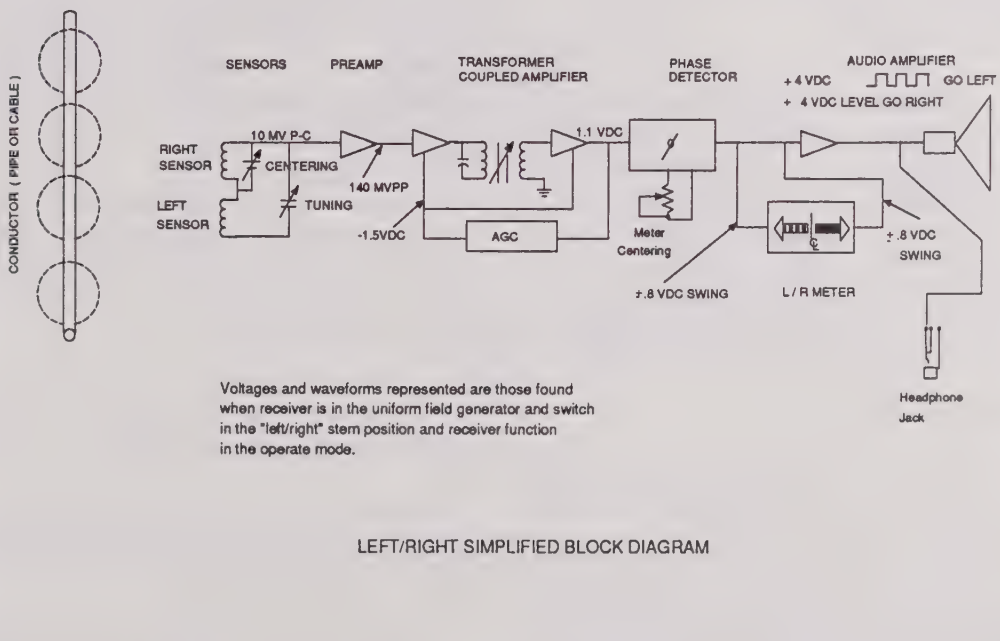


Fig. 1

Left/Right Mode Fig 2

The Left/Right sensor coils are connected in series and tuned to the 83.0775KHZ transmitted signal by a capacitor connected across both sensors. A second tuning capacitor serves to fine adjust the L/R meter needle to center. The L/R signal enters the receiver through the two coils located in the T-sections of the lower receiver antenna housing, where it is amplified and fed to the transformer tuned L/R amplifier on the plug in amplifier board in the main receiver body. The signal then goes to the phase detector where it is turned into a positive or negative DC voltage depending on where the receiver is in relation to the conductor being located. The signal now goes in two directions, one to the meter driving circuit and the other to a circuit where the positive and negative signal drives the audio steady or broken tone depending on the location relative to the conductor being traced.



LEFT/RIGHT SIMPLIFIED BLOCK DIAGRAM

Fig. 2

Depth Mode Fig 3

The depth is calculated from 2 signal strengths when the receiver is directly over the conductor being traced (centerline). One of the signals is the reference sensor signal which is applied to a computer circuit and compared to a signal from the top sensor located in the top receiver antenna housing. The top and reference coils are a standard known distance apart which is why it is very important that the receiver stem is fully extended and locked before locating. The difference between the two signals is processed through the computer board which has a built in formula for converting the difference between the two signal strengths to a DC voltage which is displayed on the LCD 3 seconds after the depth button is depressed.

Reference Channel

The signal from the reference sensor is processed the same through the tuned amplifier as in the signal strength mode. After this signal leaves the tuned amplifier it is detected by a phase detector which gets its reference from a phase locked loop. The detected output is proportional to the signal strength and stored in a subtracting circuit on the computer board.

Top Signal (depth calculation)

When the depth button is depressed the input to the tuned amplifier is switched from the reference sensor to the top sensor. At the same time, the gain of the amplifier is fixed by the AGC hold voltage caused by a timing circuit which is triggered by the depth button. At this point the reference signal is stored in the computer subtracting circuit and a new signal from the top sensor is applied to the subtracting circuit which results in the difference of the reference and top signals. This difference is processed through the computer circuits and applied to the analog to digital converter on the module and then used to drive the LCD, which indicates the depth in inches or centimeters. The receiver can be set for inches or centimeters by placing a resistor in the position marked E (english) or M (metric) on the receiver motherboard. See motherboard drawing on page 23.

Sequencer

The receiver contains sequencer or timing circuits located on the sequence/regulator PCB to switch signals and time specific events. The sequencer performs the following steps after the depth button is depressed:

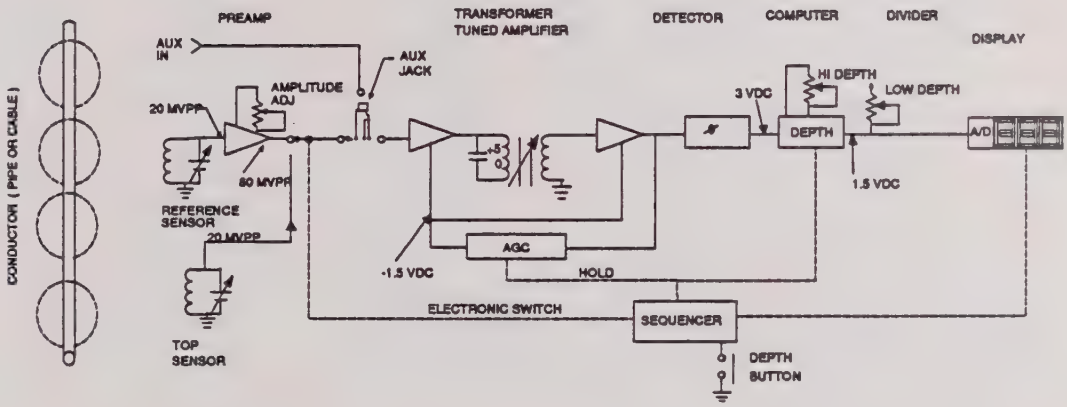
1. Freezes for 7 seconds the automatic gain control (AGC) voltage to the reference and L/R amplifiers at the level when the depth button is depressed. The gain of the reference amplifier is now exactly the same for both the top and reference signals.

2. The timing circuits causes the input to the tuned amplifier to switch from the reference signal to the weaker top signal. The top signal is weaker because it is further away from the conductor being traced.

3.The audio is turned off to conserve battery current draw and not to distract the operator.

4. The LCD which was displaying signal strength, is blanked and prepared to display the depth from the computer.

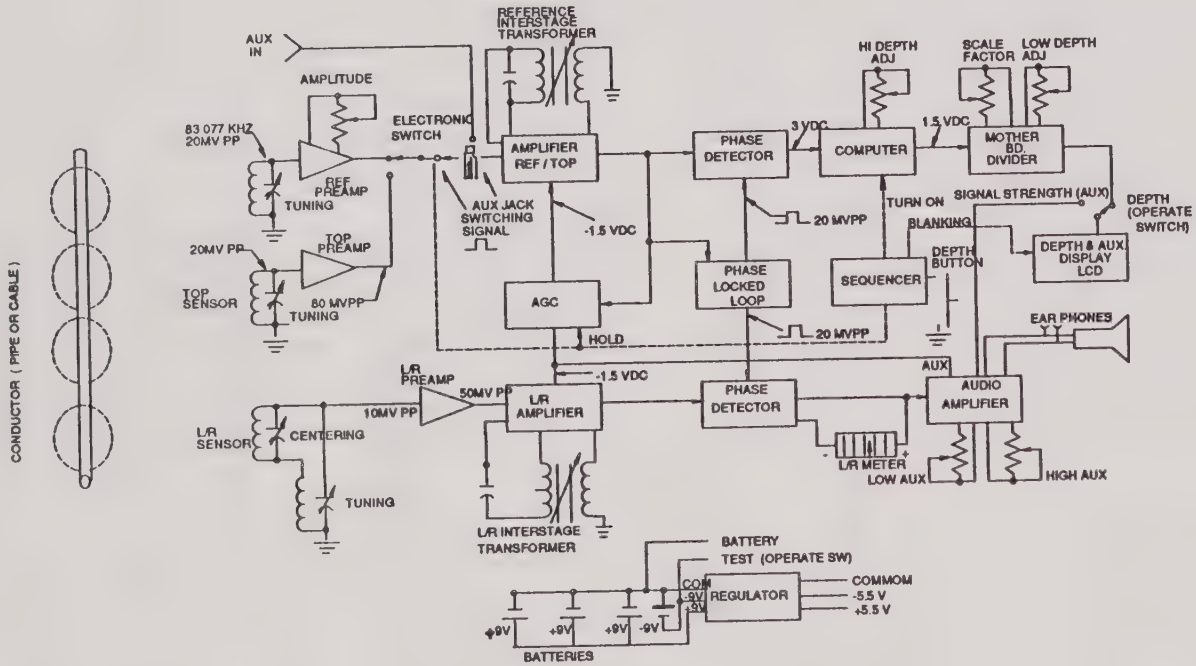
5. The computer is turned on by switching voltage to it's circuits. This computed voltage is then fed to the LCD driver and the depth is displayed.



Voltage and waveforms represented are those found when unit is placed in the uniform magnetic field generator and switch in "Norm" position.

DEPTH SIMPLIFIED BLOCK DIAGRAM

Fig. 3



Voltage and waveforms represented are found

when receiver is in the uniform magnetic field generator

OVERALL RECEIVER BLOCK DIAGRAM

Fig. 4

SUB-ASSEMBLY FUNCTIONS

Listed below are descriptions of the Receiver circuit boards which will aid in understanding unit functions.

1. Reference-Left/Right Preamp PCB (400B086)

This circuit board is located in the lower receiver housing along with the reference and L/R sensor coils. The PCB accepts the 83.0775KHZ signal from the sensors and amplifies the reference signal to 80mv and the L/R to 1-3 vdc. These voltages pertain to those seen when unit is placed on the uniform magnetic field generator. (see set up procedure on page ?). The signal then goes to the reference electronic switch located on the receiver motherboard.

2. Top Preamp PCB (400B087)

This PCB is located in the top housing on the receiver antenna. This circuit board is tuned via C1 and the top sensor coil, to 83.0775KHZ and amplifies the signal to approximately 80mv before sending it to top electronic switching located on the motherboard.

Note: *The next five PCB's are plug in modules located in the receiver body.*

3. Amplifier PCB (400B054)

This PCB is a dual channel transformer tuned amplifier. The transformers are located on the motherboard. The PCB accepts the 80mv pp signal from the preamps via the electronic switch and amplifies them to 1-3vdc depending on the received signal strength. The gain of the dual amplifiers is controlled by a voltage derived from the signal strength called the automatic gain control (AGC).

4. Detector/Meter PCB (500B018)

This PCB receives one input signal from the reference-L/R amplifier when switched by the depth button and one signal from the top amplifier. A phase locked loop located on this PCB generates the gated signal for 3 phase detectors. The phase locked loop consists of a 2.65840 MHZ varactor controlled crystal oscillator which drives a divider which in turn drives a phase changer. The phase changer drives 2 zero phase detectors, one for the reference/top channel and the other for the Left/Right channel. The third signal is shifted 90 degrees for the phase detector that locks the varactor controlled crystal oscillator to the incoming 83.0775KHZ transmitted signal.

One of the zero phase detectors converts the reference/top signal to a dc voltage proportional to the received signal and amplifies it prior to going to the computer board. The other zero phase detector converts the L/R signal from the L/R amplifier to a positive or negative dc voltage which goes to the meter driving circuit and audio pulsed or **broken tone for go left** and **solid tone for go right** to locate conductor center.

One of the other functions is to detect the reference signal in a diode and feed it back to an AGC controlled circuit on the Audio/AGC PCB.

5. Audio/AGC PCB (500B045)

The audio portion of this board provides a .5 hz interupted signal for the left portion of the L/R audio signal and a 648 hz constant tone for the right audio signal.

The AGC comes to this PCB from the detector PCB and goes through a hold switch and dc setting operational amplifier back to the reference and L/R amplifiers. This circuit also provides for the low and high AUX or signal strength (see page 31).

6. Sequence/Regulator PCB 500B046

The sequencer provides the timing signals when the depth button is depressed to accomplish the following:

1. freezes the AGC voltage for both the reference and L/R channels.
2. blanks the LCD display
3. switches off the audio
4. switches the input of the reference amplifier to the top signal.

5. applies voltages to the computer for depth calculation.
6. turns the LCD on to display the depth
7. switches the LCD from the AUX circuit to the computer output and display Depth.
8. resets the sequencer.

The regulator portion of this board regulates the 9+/- battery voltage to +/- 5v.

7. Computer PCB (500B016)

The computer takes the signals from the output of the reference/top amplifier when the depth button is depressed and stores it in a subtractor circuit. The new lower amplitude signal from the top sensor is subtracted from the reference signal. The result is integrated and compared to a clock pulse from the phase locked loop and charges a capacitor at the input of an operational amplifier. The ouput is applied to the analog to digital converter on the display. There is also an adjustment on this board for calibrating High depths.

8. Display Module

The display module consist of the 40 pin analog to digital converter, LCD driver, and the 3 digit display, mounted on a common printed circuit board, which is located in the display housing. Its function is to take the analog signals of field strength and depths; convert them to a digital signal, then the LCD driver will drive the 3 digit display allowing user to numerical read depths in inches or centimeters and relative field strenghts .

ACCESSORIES
METROTECH MODEL 4820 METROCLAMP (OPTIONAL)

The 4820 Metorclamp is inductive clamp which is tuned to 83.0775 KHZ . It is used to induce a signal onto a conductor in which a direct connection cannot be made (energized cable). In each potted half of the clamp, there are wound cores. Under the model plate, there is a small circuit board which contains capacitors to tune the frequency.

In order for the clamp to function properly, the clamp must fully close around the conductor (4" diameter). At the pivot point of the clamp (see figure 5 there must be an air gap of a minimun of .007". This must be clean and free of dust, dirt, etc.. In addition, the plug must be checked for continuity so that the signal can travel to the clamp area. See page 35 for instructions to adjust the 4820 clamp.

The conductor to be traced must be grounded at both ends for the clamp to function properly. For this reason, there is a red jumper lead supplied to jump insulators on meters, etc.. The jumper should also be checked for continuity.

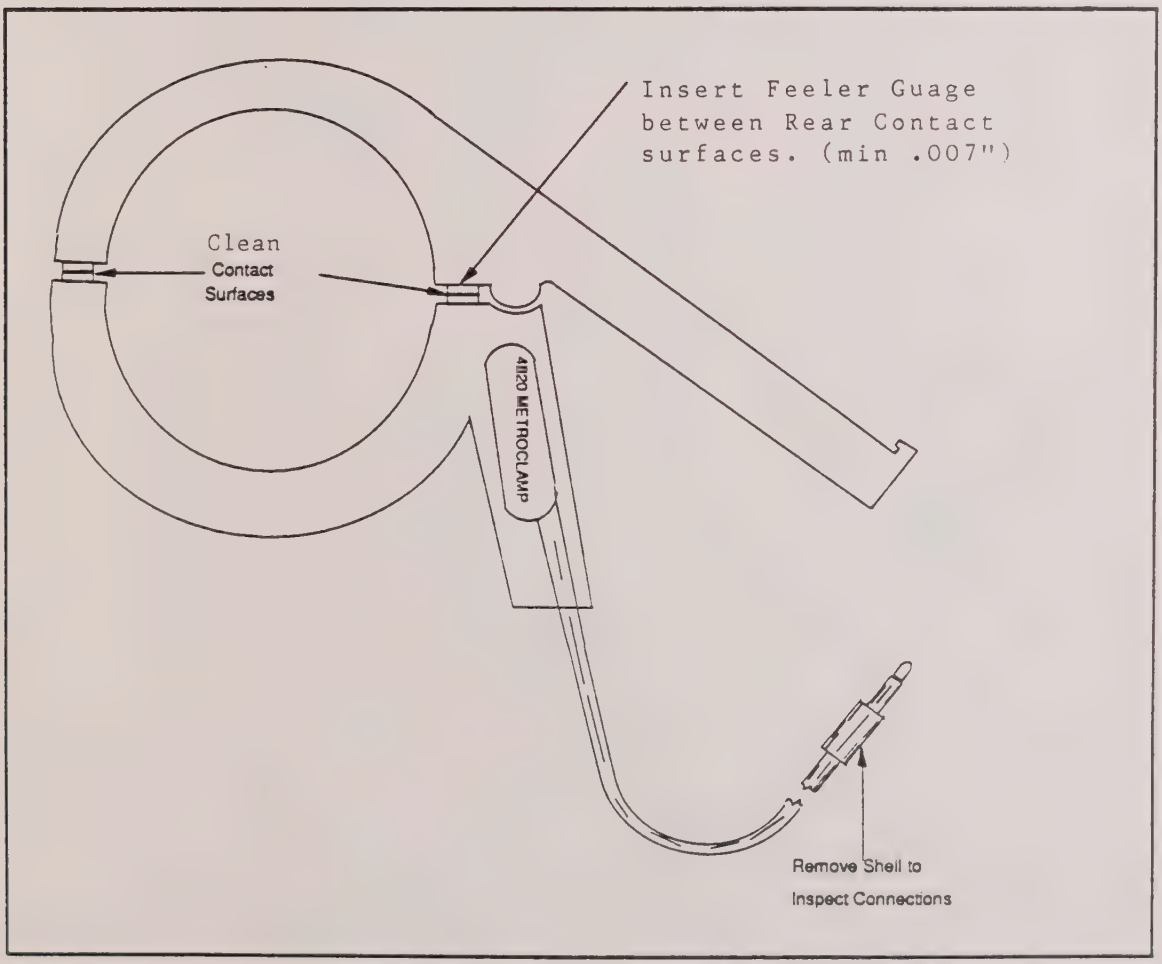


Fig. 5

CONDUCTIVE ATTACHMENT ASSEMBLY (Metrotech Part Number 800B004)

The conductive attachment assembly consists of the connecting cable, grouding spike and ground plate. This assembly is used on locates where a direct connection can be made onto the conductor (water and gas pipe). The plug is plugged into the transmitter direct output jack. The red lead is attached to the conductor and the black lead to ground. A ground spike is used on locates where there is soft ground and the plate is used on cement, asphalt, etc.

The connections to the plug should be checked to ensure that there is continuity as well as the two clamp connections. In addition, the spike and ground plate should be clean and free from dirt, rust, etc..

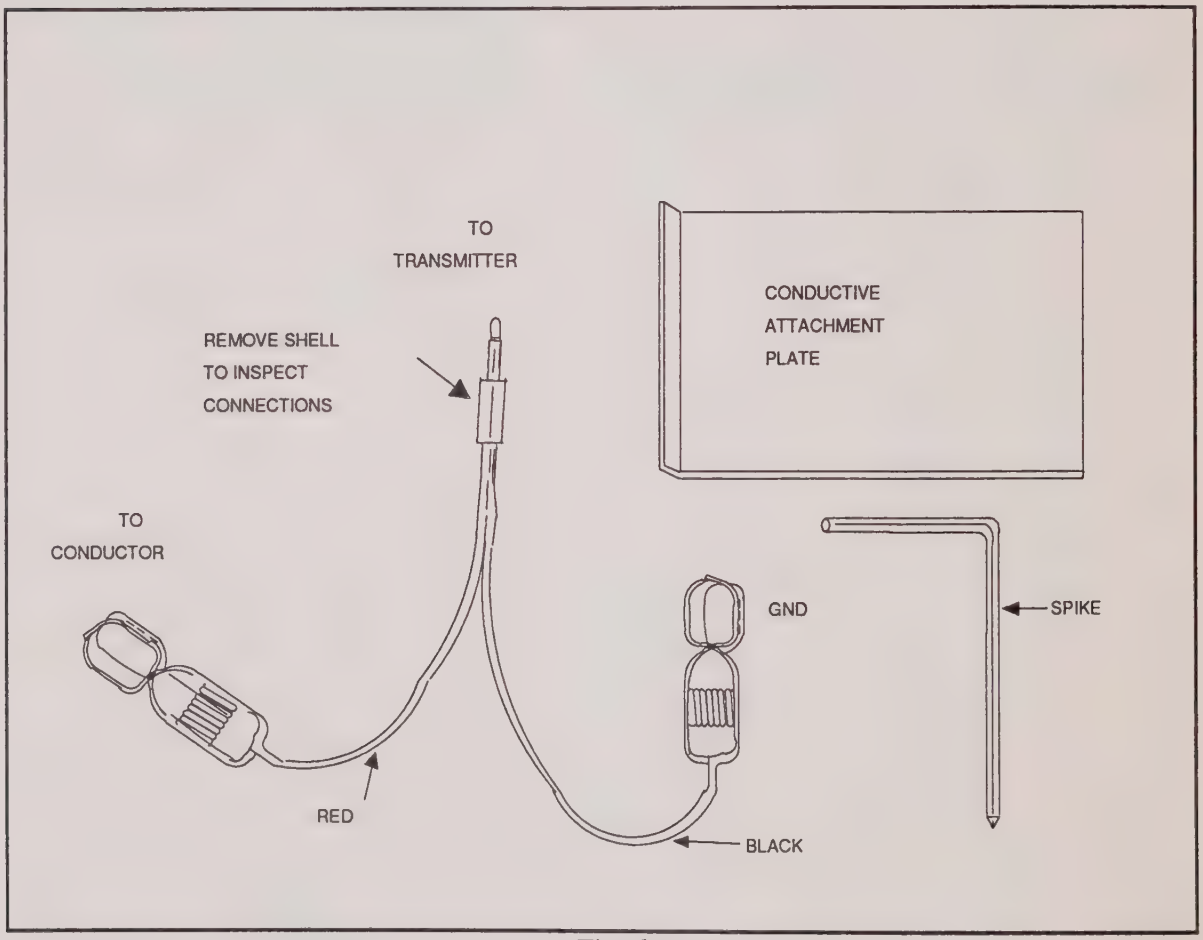


Fig. 6

CHECKOUT PROCEDURE

A brief performance check of the Model 810 should be performed as per the following procedure to determine significant operating features without the use of test equipment or test field. This procedure should be used on a periodic basis by the unit operator to check the the basic unit functions. This is not a troubleshooting or calibration procedure.

WARNING:
Do not operate the transmitter while it is resting on or near a metal surface or large metal object. Incorrect test results and damage to the transmitter may result.

There are two methods of placing the transmitted signal onto the conductor to be located. The first is the inductive method in which the signal is induced by electromagnetic induction onto the target conductor. The ouput signal is radiated by the directional antenna located in the transmitter. See operator's manual for additional information.

The second method is called the conductive or direct connect method. In this method, a metallic contact is made between the output signal generated from the transmitter and the conductor to be located.

In addition, a 4820 Metroclamp can be used to couple signal onto the target conductor. This clamp must completely surround the conductor for proper results which will fit around a 4" conductor.

INDUCTIVE METHOD

1. Ensure that the accessories are present(conductive attachment assembly and optional 4820 Metroclamp if needed) which are a major part of the 810 Line Tracer. A high number of unsuccessful locates are a result of a defective conductive attachment or inductive coupler. Pull transmitter on/off switch to the on position. Depress battery indicator button and ensure LED illuminates.

2. Fully extend and lock the receiver antenna. Place the receiver function switch in the battery position. The meter indicator should move beyond the "BATT TEST" line on the meter. Disregard any audio tones while in this position.

3. Place the receiver function switch in the "AUX" position. This is the 4th position on the rotary switch . Point the receiver at the transmitter as in the figure 7.

In this position, the LCD readout on the receiver display should be 950 or above as in figure 9B.

4. Place the receiver function switch in the operate mode (3rd position). Point the receiver at the transmitter as in the figure above except 2-5 feet away, see figure 8.
In this position, the left/right meter should read a centerline condition (needle in the center of the meter and no audio tone) figure 9B. As the receiver is pointed to the right and left of centerline, the meter should indicate a go right indica-

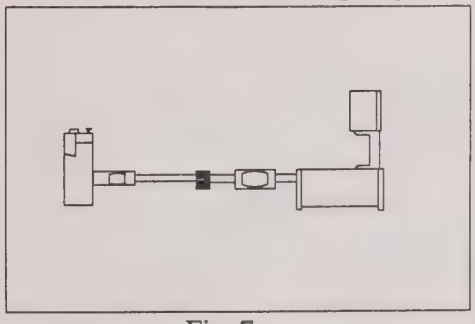


Fig. 7

tion(needle in the solid arrow portion of meter and constant audio tone) or go left (needle in the broken arrow portion and broken audio tone)respectively, figure 9A and 9C.

6. Obtain a centerline condition by pointing the

receiver at the transmitter as in step 5. While holding the receiver as still as possible, press and release the depth button. The LCD will flash a series of numbers for approximately 5-7 seconds. During the last 2 seconds a number should stay constant. The number displayed will not be the actual distance from the transmitter due to the external influences while in the inductive mode. Place the receiver function switch in the off position.

CONDUCTIVE METHOD

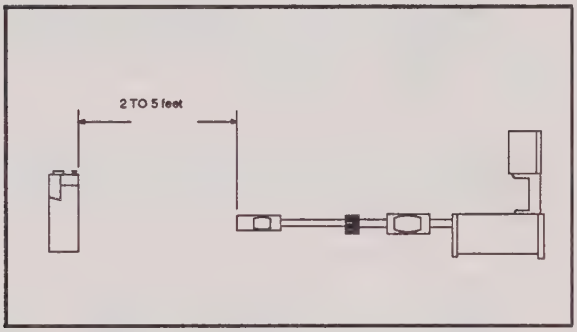


Fig. 8

7. Place the transmitter in the off position. Plug the conductive attachment assembly into the transmitter direct output jack. Attach the connectors on the ends of the red and black leads and form a loop as in the figure 10. Turn the transmitter on.

8. Place the receiver function switch to the operate mode and obtain a centerline condition over the wires of the conductive attachment. Observe that the field strength is over 950 which indicates that continuity exists on the conductive attachment. Press and release the depth button and observe that the depth indicates 0-1 inch.

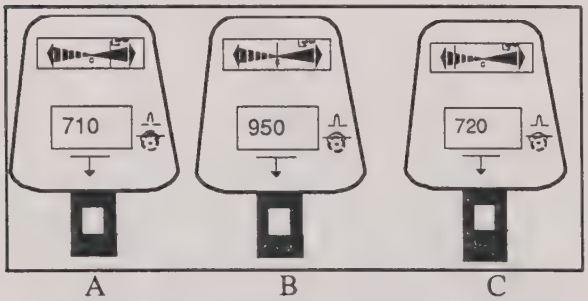


Fig 9

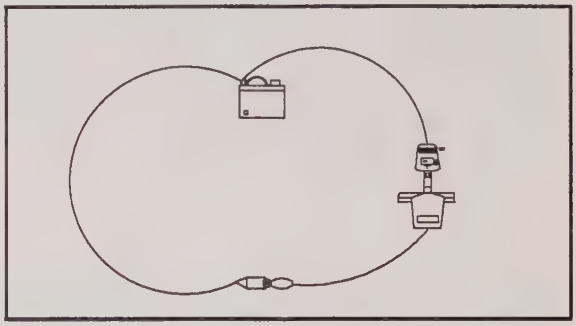


Fig. 10

CLAMP METHOD

9. Plug the optional 4820 metroclamp into the AUX input jack located on the receiver rear panel (battery access door). Clamp around either the red or black lead of the loop. The receiver LCD should read above 950 indicating correct operation of the clamp. With the clamp plugged into the receiver as in this method, the receiver antenna is not used in the circuit and the clamp becomes the receiver antenna. This is used in the field to clamp around cables for identification by pure signal strength.

This procedure is provided as a quick check for units in for repair. The next step is to check out the unit on a "known conductor" or test field as in the next section.

TEST FIELD

In order to properly test and calibrate the Model 810 line tracer, it is necessary to have a "KNOWN BURIED CONDUCTOR" as a test field.

The test field is referred to as a "Known Buried Conductor" in the Service Manuals. In selecting a test sight, there are several items to take into consideration. Select a length of buried pipe or cable which is free of parked automobiles, metal fences and other buried or surface metal objects which may intefere with the transmitted signal. The exact position of the conductor should be marked on the ground including the depth. Where possible, the location and depth should be known by exposing the conductor.

Best results will be obtained if the conductor is 24-48" in depth, has a small diameter and is straight for at least 60 feet. If there is no access to a buried conductor, a wire run along the surface of the ground can be used. The wire must be grounded at both ends. Calibration or checkout must only be done using the direct connection or coupler and NEVER in the inductive mode.

This procedure using a "known conductor" should be used by the unit operator on occasion to verify proper function of the unit. This helps build confidence in the unit and may assist the operator in identifying an application problem.

Refer to figure 11 for test field drawing.

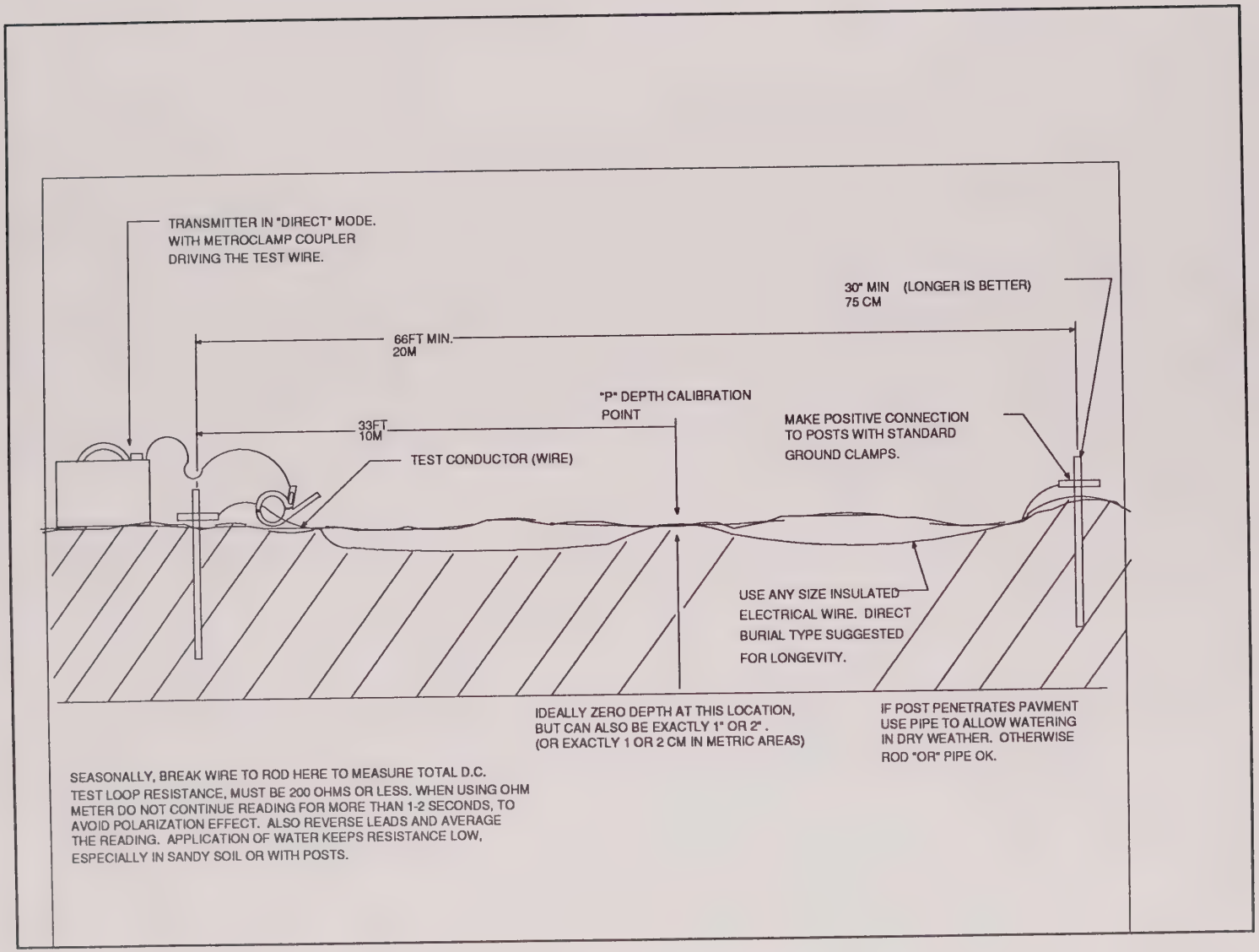

TRANSMITTER IN "DIRECT" MODE.
WITH METROCLAMP COUPLER
DRIVING THE TEST WIRE.
30" MIN (LONGER IS BETTER)
75 CM
66FT MIN.
20M
"P" DEPTH CALIBRATION
POINT
33FT
10M
TEST CONDUCTOR (WIRE)
MAKE POSITIVE CONNECTION
TO POSTS WITH STANDARD
GROUND CLAMPS.
USE ANY SIZE INSULATED
ELECTRICAL WIRE. DIRECT
BURIAL TYPE SUGGESTED
FOR LONGEVITY.
IDEALLY ZERO DEPTH AT THIS LOCATION,
BUT CAN ALSO BE EXACTLY 1" OR 2" .
(OR EXACTLY 1 OR 2 CM IN METRIC AREAS)
IF POST PENETRATES PAVMENT
USE PIPE TO ALLOW WATERING
IN DRY WEATHER. OTHERWISE
ROD "OR" PIPE OK.
SEASONALLY, BREAK WIRE TO ROD HERE TO MEASURE TOTAL D.C.
TEST LOOP RESISTANCE, MUST BE 200 OHMS OR LESS. WHEN USING OHM
METER DO NOT CONTINUE READING FOR MORE THAN 1-2 SECONDS, TO
AVOID POLARIZATION EFFECT. ALSO REVERSE LEADS AND AVERAGE
THE READING. APPLICATION OF WATER KEEPS RESISTANCE LOW,
ESPECIALLY IN SANDY SOIL OR WITH POSTS.

Fig. 11

OUTSIDE TEST PROCEDURE

This procedure should be used to check the functions of the Model 810 receiver, transmitter and accessories on a properly energized test field or known conductor (see page 14). Upon receipt of a defective unit from the field, this procedure along with the checkout and tuning procedure will assist the repair technician in defining problems.

1. Connect the transmitter to the test field using either the direct connect or inductive coupling method. **NOTE:** *This process should NOT be performed in the inductive mode.*

2. Turn the transmitter to the on position. Fully extend and lock the receiver antenna and place function switch to the operate position. Obtain a centerline condition and observe that the meter indicator is in the center of the meter and that there is no audio tone. The field strength should reach a maximum reading as the centerline is obtained. (see figure 12)

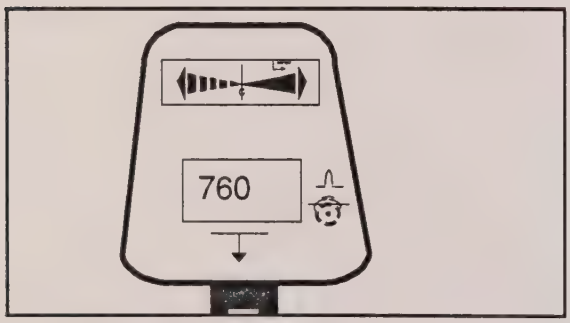


Fig. 12

3. Step to the left of center and observe that the left/right indicator moves to solid arrow portion of the meter and the audio tone is constant. Also observe that the field strength decreases as the receiver is moved away from center. (See Figure 13)

4. Obtain a centerline condition and observe that the meter indicator is in the center of the meter and that there is no audio tone.

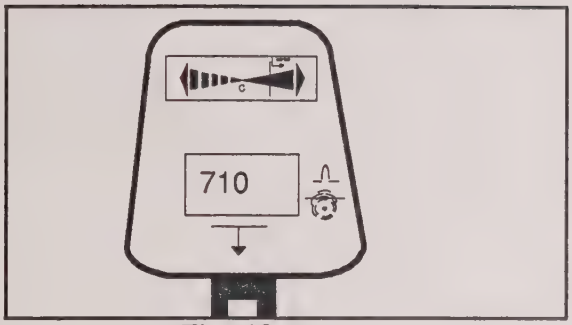


Fig. 13

5. Step to the right of center and observe that the left/right indicator moves to the broken arrow portion of the meter and the audio tone is also broken or pulsed. Also observe that the field strength decreases as the receiver is moved away from center. (See Figure 14)

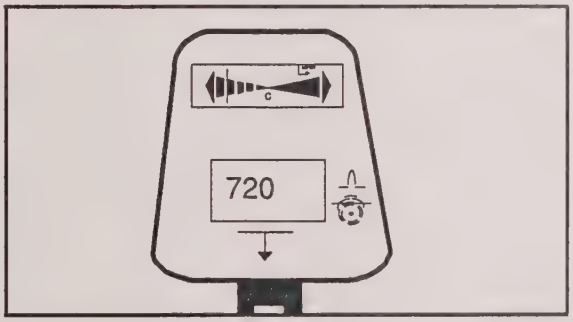


Fig. 14

6. Once again, obtain a centerline condition and ensure that the receiver is directly over and vertical to the the conductor. Depress and release the depth button. Observe that after approximately 3-5 seconds, the actual depth of the test field is displayed for 2 seconds.

This procedure checks that the basic functons of the unit are functioning. However, even if the unit passes this procedure, the receiver should be tuned (see section 11) to prevent a future field failure and to ensure proper field calibration.

810 RECEIVER TROUBLESHOOTING CHART

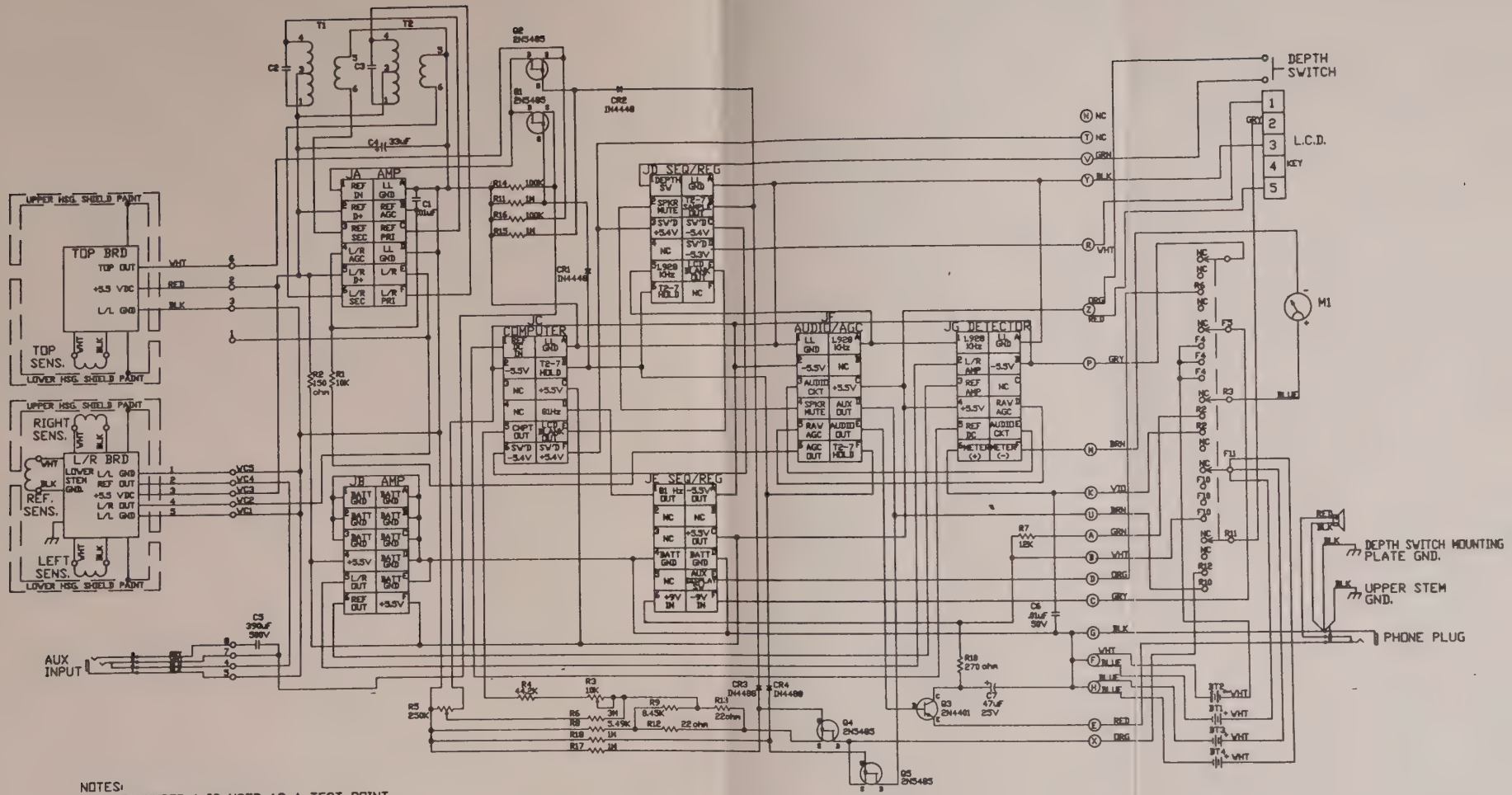
SYMPTOM	CAUSE
No ref. out signal	(a) check for +5 vdc in the sensor (b) check for open or broken coil wires (c) check coil cord connections on motherboard & ref .sensor (d) defective sensor, determined by ohm meter. (e) moisture in the sensor housing (f) pinched wires (g) components touching conductive paint
No L/R out signal	(a) same checks as above
No top signal output	(a) check continuity of red/white/black wires coming from the top sensor. (b) same as above except item C
Weak or erratic L/R	(a) replace Amplifier PCB (b) replace AGC/Audio PCB (c) replace Det/Meter PCB (d) check L/R sensor
No audio, no display No meter indication	(a) replace Det/Meter PCB (b) check +5 & -5V supply (c) replace Regulator PCB
No audio	(a) replace detector/meter PCB (b) check speaker
No display, audio ok	(a) replace Computer PCB (b) replace Det/Meter PCB (c) check LCD display
Depth inaccurate	(a) recalibrate Computer PCB (b) Computer PCB (c) check ref. & top sensor output (d) Audio/Agc PCB (e) check LCD display
No display	(a) check wire connections to the display plug. (b) defective Det/Meter PCB (c) Computer PCB defective (d) check LCD

810 RECEIVER TROUBLESHOOTING CHART CONT.

SYMPTOM	CAUSE
Rx BATT. Test reads ok, but unit does not operate	All 4 batteries must be change, not just 3 in positive circuit.
Some positions of Rx mode switch OK, others are inoperative.	Check for broken switch or contacts touching cover. Are all cards plugged in? Substitute good cards, one by one, & calibrate per outside calibration procedure.
Left/Right and Depth function out of spec.,	Tuning incorrect (see Tuning procedure). Substitute good card, one by one & calibrate per outside calibration procedure.
Left/Right ok, but depth incorrect (yet steady)	Measure +/- 5.5V, see Voltage in tuning section. See Repair section if voltages are incorrect. Tune and calibrate Rx per outside calibration procedure.
Left/Right ok, but depth drifts during readout period.	Measure stability of +/-5.5V. See Voltage figure and chart in tuning section. See Repair section if voltage drifts, or change Audio-AGC and Computer Cards, LCD and tune and calibrate Rx per outside calibra-tion procedure.
Left/Right inaccurate, but Depth ok.	Change Amplifier card, then Detector card. If not improvement, check for L/R antenna output per Volage Chart in tuning section.
Depth accuracy ok on test wire strong signals, but readings change with weaker signals.	Orange cover on electronics section not grounded with screw to chassis.
Depth reading different when going toward Tx than when going away.	*Check that the test wire loop resistance is less than 200 ohms. Antenna shield grounding broken. See repair section.

*This could be caused by operating too closely to multiple conductors which distort the magnetic field around the top sensor. Different application of the transmitter may improve the to/from readings.

Helpful Hint - To verify proper operation of the receiver antenna (reference and top signal), plug a 4820 METROCLAMP into the AUX jack on the rear panel of receiver. Example: 000's on display . Plug in clamp and clamp around attachment as in checkout procedure. If 950 or above readout appears on the display the problem is in the stem assembly.

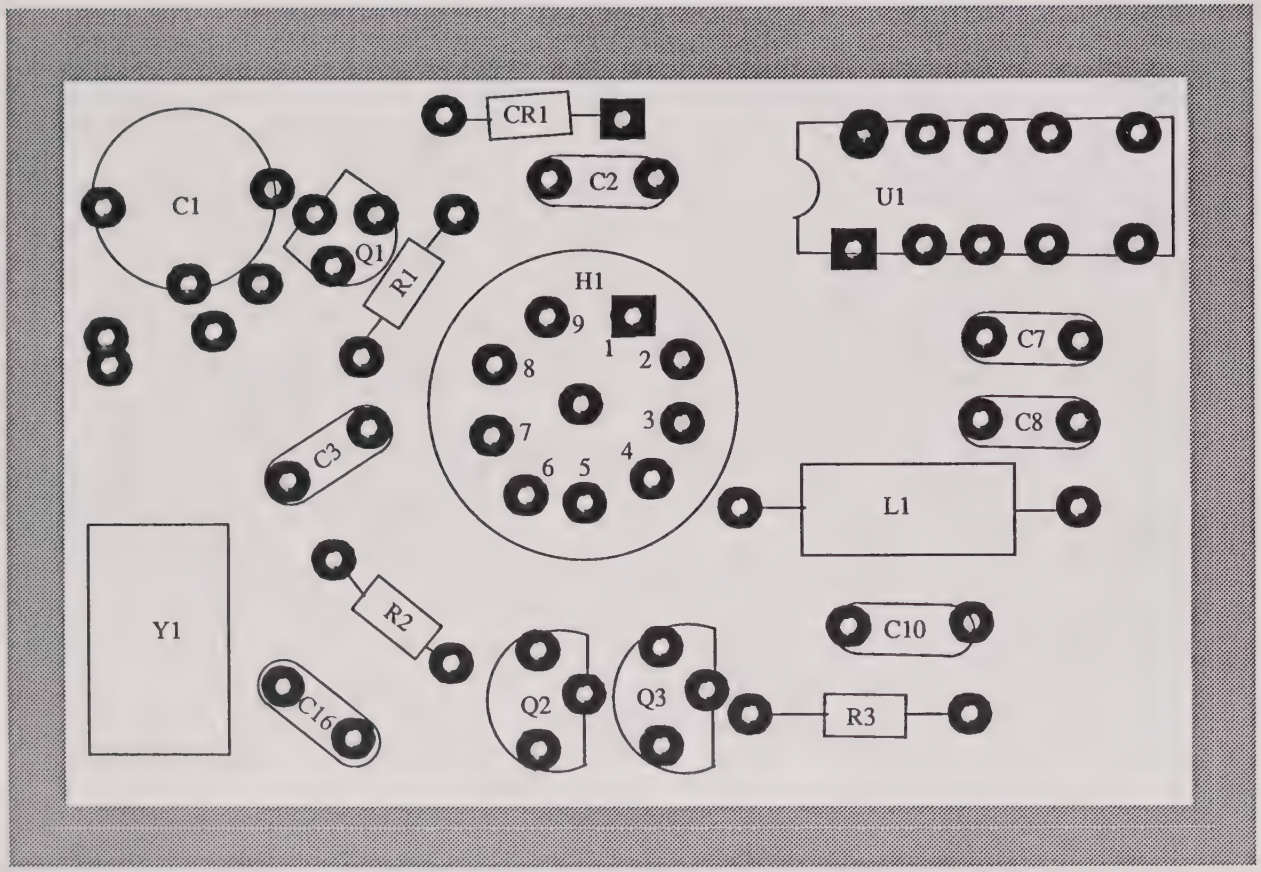


NOTES:
1. HOLE NUMBER 1 IS USED AS A TEST POINT.
2. COMPONENT DIFFERENCES BETWEEN THE R-810 & R-850 MOTHER BOARDS ARE:

COMP.	R-810	R-850
T1&T2	500B131	500C032
C2&C3	.002uF 200V 1%	.01uF 160V 1%

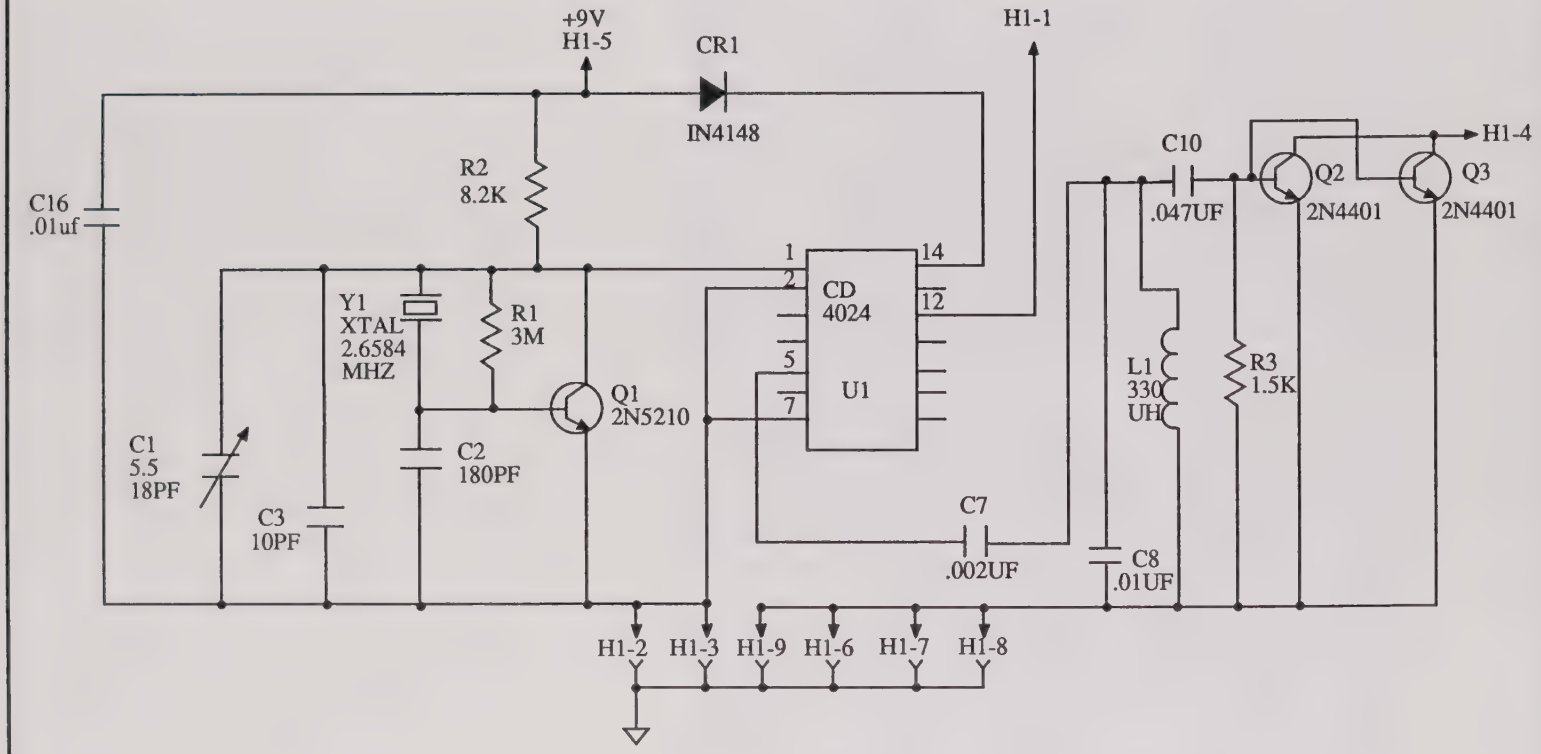
810 TRANSMITTER TROUBLESHOOTING CHART

SYMPTOM	CAUSE
Transmitter Power Test Lamp sometimes dims or doesn't light at all	Batteries are weak. Replace. If in Inductive mode, test must not be made with Tx on or near metal surface (truck floor, metal bench, etc.) Check battery contacts for firm pressure. Be sure battery hold-down plate is being used. If only in Direct mode with Metroclamp, is Metroclamp pivot properly anchored and adjusted for correct gap of .004-.010(.1-.25mm).
Tx battery life short (should be 75-150 hours)	One cell installed in reverse from label. Check tuning of both modules.
Tx Power Test Lamp doesn't light but Tx OK otherwise.	Check POWER TEST switch and lamp.
Tx output OK on Inductive mode but nil on DIRECT mode.	Check switching contacts on DIRECT jack. Figure 1.
Tx output always nil.	Check batteries and contacts with voltmeter (POWER switch on). Check module by substitution.
Tx output appears OK, but causes L/R meter neeedle to move constantly from one side to the other.	Crystal damaged. Substitute Tx module.



ASSY, P.C.B. TRANSMITTER

Figure 16



SCHEMATIC, MODULE TRANSMITTER

FIGURE 17

810A TRANSMITTER TUNING (S/N 3735 & ABOVE)

1. With the Tx placed at least 1 foot (30cm) away from any sheet metal surfaces or tuned circuits (antennas, etc.) resonant at or near 83 KHz, unlatch and fold back the top hinged panel, and place multimeter across the terminals of the push-pull POWER SWITCH (with the switch in the off position). Its meter switch settings range should be approx. 0-150 ma D.C.

2. Tune the Inductive output circuit by adjusting the compression mica trimmer, (figure 1-1), for minimum current, which should be 65-105 ma.

3. Tune the DIRECT output circuit by inserting an ordinary phone plug (nothing connected) into the DIRECT Jack, then adjust (by hand) the outer cup portion of the ferrite cup core assembly on the mother board for minimum current, (figure 1-1), which should be 30-45 ma. (core must have 2 minimum points which will show identical values).

4. If 3) is done correctly, the current will be less than 115 ma. if the test plug is temporarily shorted.

5. It is advisable to make this further test of the transmitter and POWER TEST lamp calibration:

Temporarily remove a cell from each row and connect a variable power supply to the battery contacts (with positive to the red terminal on the right). With the multimeter connected across the POWER switch as above the supply set at 7.0 volts, the POWER TEST lamp should glow when the TEST button is pressed, whether in the Inductive (step 2) or DIRECT (step 3) mode. At approximately 5 volts, the lamp should not glow.

If there is trouble in any of the Tx tests, recheck the tuning steps and, if necessary, try substituting the Tx module.

810A TRANSMITTER TUNING (S/N UP TO & INCLUDING 3734)

1. . With the Tx placed at least 1 foot (30cm) away from any sheet metal surfaces or tuned circuits (antennas, etc.) resonant at or near 83 KHz, unlatch and fold back the top hinged panel, and place multimeter across the terminals of the push-pull POWER SWITCH (with the switch in the off position). Its meter switch settings range should be approx. 0-150 ma D.C.

2. Tune the Inductive output circuit by adjusting the compression mica trimmer, (figure 3-1), for minimum current, which should be 30-45 ma.

3. Tune the DIRECT output circuit by inserting an ordinary phone plug (nothing connected) into the DIRECT Jack, then adjust (by hand) the outer cup portion of the ferrite cup core assembly on the mother board for minimum current, (figure 3-1), which should be 30-45 ma. (core must have 2 minimum points which will show identical values).

4. If 3) is done correctly, the current will be less than 115 ma. if the test plug is temporarily shorted.

5. It is advisable to make this further test of the transmitter and POWER TEST lamp calibration:

Temporarily remove a cell from each row and connect a variable power supply to the battery contacts (with positive to the red terminal on the right). With the multimeter connected across the POWER switch as above the supply set at 7.0 volts, the POWER TEST lamp should glow when the TEST button is pressed, whether in the Inductive (step 2) or DIRECT (step 3) mode. At approximately 5 volts, the lamp should not glow.

If there is trouble in any of the Tx tests, recheck the tuning steps and, if necessary, try substituting the Tx module.

810 RECEIVER TUNING

ANTENNA TUNING

This procedure tests and aligns the receiver on a test bench after field testing. During field test, it may have been determined that there is a problem with the basic function of the unit. Many times these problems are tuning related and can be resolved using this procedure. In addition, this procedure must be performed after replacement of a part and prior to outside test before returning the unit to the field.

EQUIPMENT REQUIRED

Dual channel scope with 5mv sensitivity and minimum of one microsecond sweep and external trigger. Uniform magnetic field generator(Metrotech part number 300C006), dual and single extenderboards supplied with test kit.

Refer to Figure 18 For Equipment Set-up

1. Remove antenna housings or housing filler plates as per procedure on page 40.

2. Insert receiver in test fixture as shown in setup figure 18, making sure the stem is collapsed. The receiver should be flat on surface of test fixture.

3. Adjust the "Low Depth Adjustment Pot" see fig 19 to Minimum full counter-clockwise. Adjust the "depth Scale Factor Pot" to mid-range.

4. Remove Audio/Agc PCB (500B045) and Computer PCB (500B016) from receiver.

5. Check the four 9v receiver batteries for a minimum of 7.2v each.

6. Set mode switch on test fixture to "Normal" position.

7. Connect the scope Channel A with a 1/1 probe to the top sensor output on the receiver motherboard (see figure 18). Set amplitude/division on scope to 20mv per division. Locate the top sensor trim cap C1 on the top preamp PCB (400C087) located in the upper receiver housing (see assembly drawing on page 30 figure 21).

8. Rotate trim cap C1 a full 360 degrees and note that there are two peaks. Adjust for maximum output (ensure that signal level is no less than 74mv pp.)

9. Connect scope Channel B with a 1/1 probe to the reference amplifier on the receiver motherboard (blue wire see figure 18). External trigger the scope from the signal source. Locate the reference sensor trim cap C9 on the reference/left-right preamp PCB (400C086) see assembly drawing on page 32, fig. 23 Rotate trim cap C9 a full 360 degrees and note 2 peaks. Adjust for maximum output.

10. Superimpose scope channels A and B over each other. Adjust the reference gain pot R9 on the reference/left -right preamp PCB (400C086) so that the reference and top signals are identical in amplitude. It may be necessary to slightly adjust the reference trim cap C9 on the reference preamp PCB to match the phase relationship exactly.

NOTE: IT IS EXTREMELY IMPORTANT THAT THE REFERANCE AND TOP SIGNALS ARE MATCHED IN AMPLITUDE AND PHASE.

11. Attach the scope Channel A to the left/right sensor output on the receiver motherboard (feed through next to coil cord-see figure 18). Move switch on test fixture to "left/right" position. Adjust the left/right trim cap C2 on reference/left- right preamp pcb to maximum. Signal should be 400mv minimum.

12. Place the Detector/Meter PCB (400B056) on a single connector extender card. Attach jumper wire from input pin 2 to ground. Adjust R27 on the Detector/Meter pcb (center pot figure 19) to center the left/right meter. remove jumper wire and extender card and re-install detector/meter pcb.

13. Place Amplifier PCB (400B054 on double connector extender card. Attach black lead of Manual AGC Generator (300B037) to JA-A and the red lead to to JA-B of extender card. Attach scope channel A to left/right output (JB-5 on extender card. Attach scope Channel B to Top/Reference output (JB-6 on extender card). Adjust Manual AGC Generator until left/right and reference signals are approximately 1 volt.

14. Adjust reference Transformer T1 on receiver motherboard for maximum output on channel B. figure 19.

15. Adjust Left/Right Transformer T2 on motherboard for maximum output on channel A. When adjusting the transformers, it may be necessary to adjust the Manual AGC Generator in order to display waveforms on scope. figure 20.

16. Remove AGC Generator and extender card and re-install Amplifier.

810 RECEIVER ADJUSTMENTS

The tuning of the Model 810 receiver is critical to a successful locate. Listed below are the key adjustments used on the receiver and the functions of the adjustments.

Reference-Left/Right PCB(part number 400C086)

R9 on this board is a 500 ohm pot used to set the amplitude of the reference signal. (figure 23)
C1 on this board is 6-50pf cap used as a coarse adjust on the left/right meter centering.(figure 23)

Top Preamp PCB (400C087)
C1 on this board is 6-50 pf cap used to peak the top signal. (figure 21)

Receiver Motherboard
Transformer T1- Transformer T1 is the reference signal impedence matching transformer used between the first and second stage of amplification (figure 19.)

Transformer T2- Transformer T2 is the left/right signal impedence matching transformer. (figure 19)

Depth Scale Factor Pot(250K ohm pot)- This pot is used to obtain linearity between the high and low depths. May be referred to as mid-range. (figure 19)

Zero Depth Pot (10K ohm pot)- This pot is used to adjust the depth to zero on the outside test field. (figure 19)

Inches or Centimeter Setting- This is a 22 ohm resistor on the motherboard that is placed is the position marked E for English or M for metric depth readings. (figure 19)

Computer PCB (part number 500B016)
R24 on the computer pcb is a 500K ohm potentiometer used to set the depth normally at the high ranges (48 inches or higher). (figure 19)

Audio/AGC PCB (part number 500B045)
R23 is a 500K ohm trim pot (outside pot marked Y) which is used to set the low signal strength. This is covered in section 12. R15 on this board (100K pot marked x) which is used to set the high signal strength. (figure 19)

Detector/Meter PCB (part number 500B018)
R27 on this board is a 250K ohm pot used as a fine adjustment for the left/right meter centering.

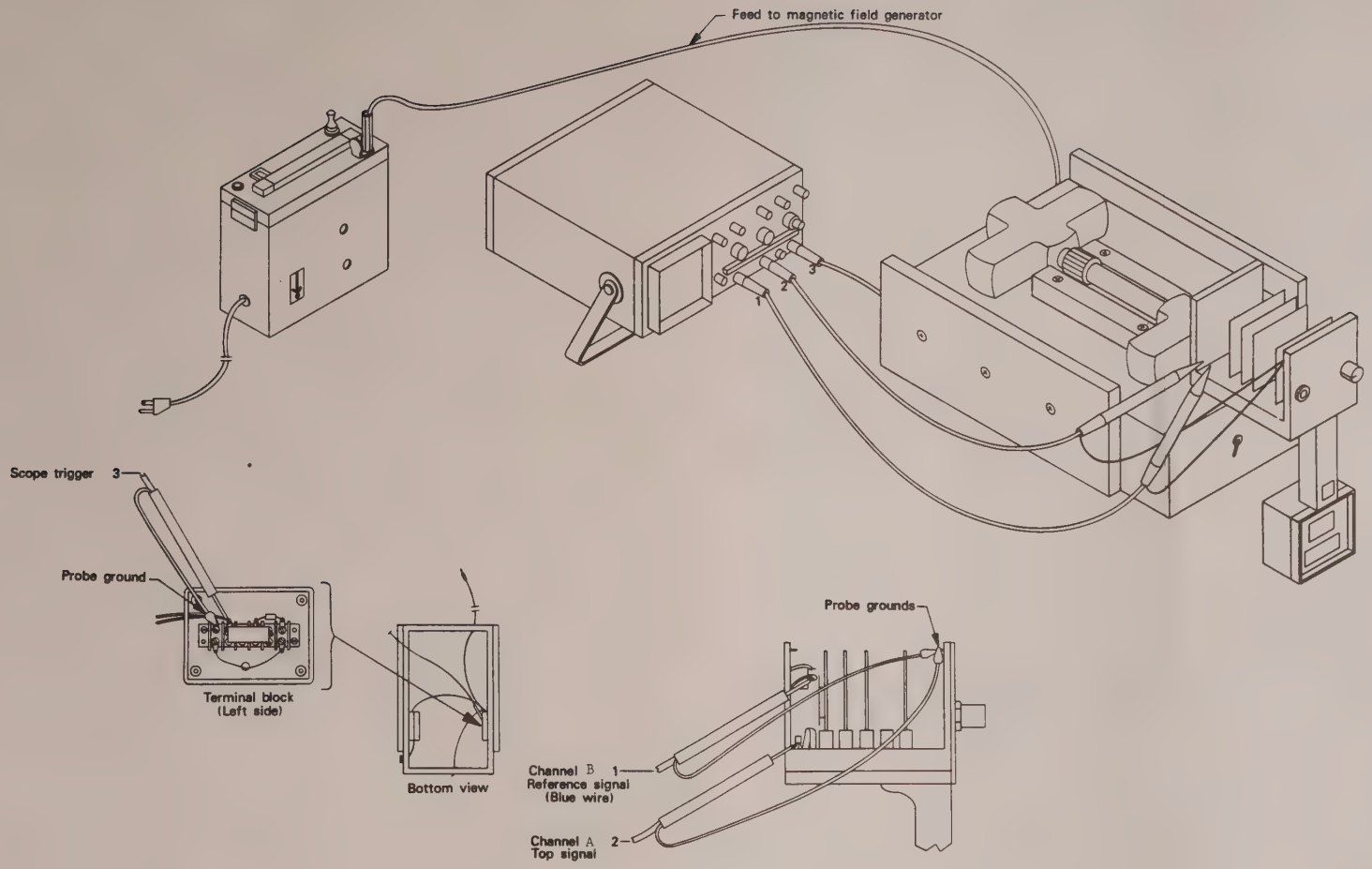
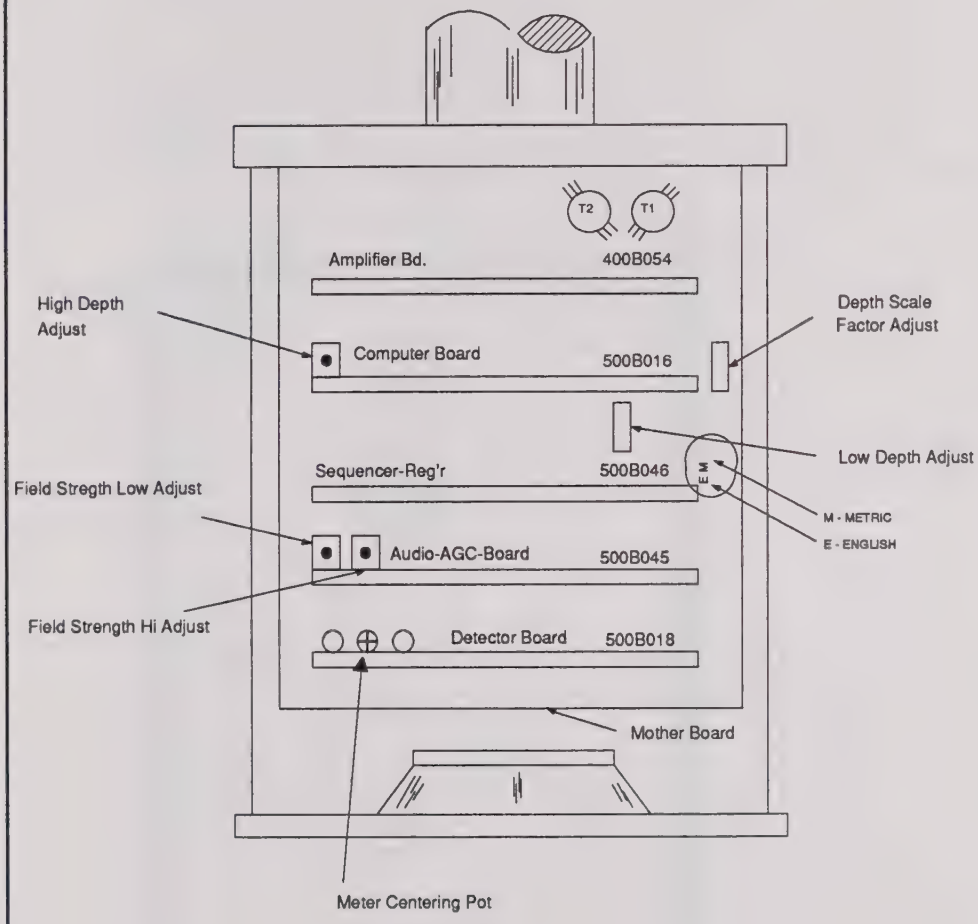
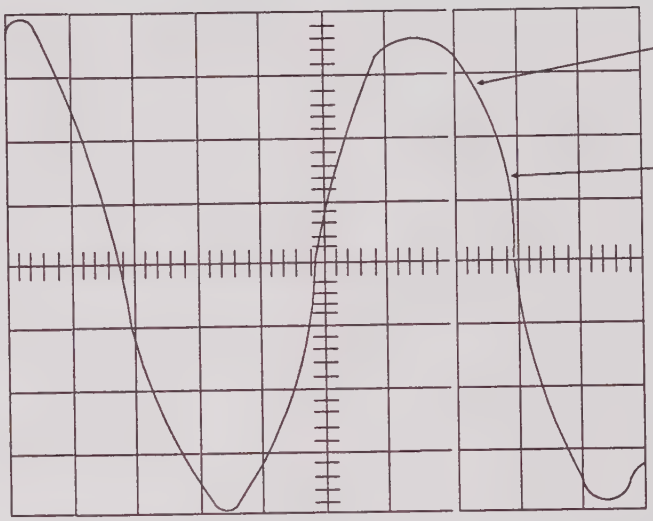


Fig. 13
Page 27



RECEIVER ADJUSTMENT

Fig. 19

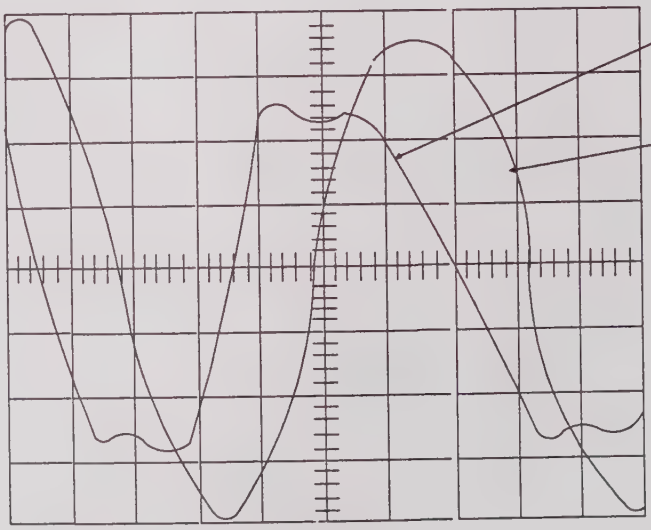


REF. SENSOR OUTPUT
80MV ± 5MV, JA-1
CHANNEL "A".

TOP SENSOR OUTPUT
80MV ± 5MV, WHITE
WIRE ON MOTHER
BD., CHANNEL "B".

NOTE:
REF. SENSOR OUTPUT
AND TOP SENSOR
OUTPUT MUST BE
IDENTICAL

REFERENCE & TOP SENSOR PHASE AND
AMPLITUDE MATCH

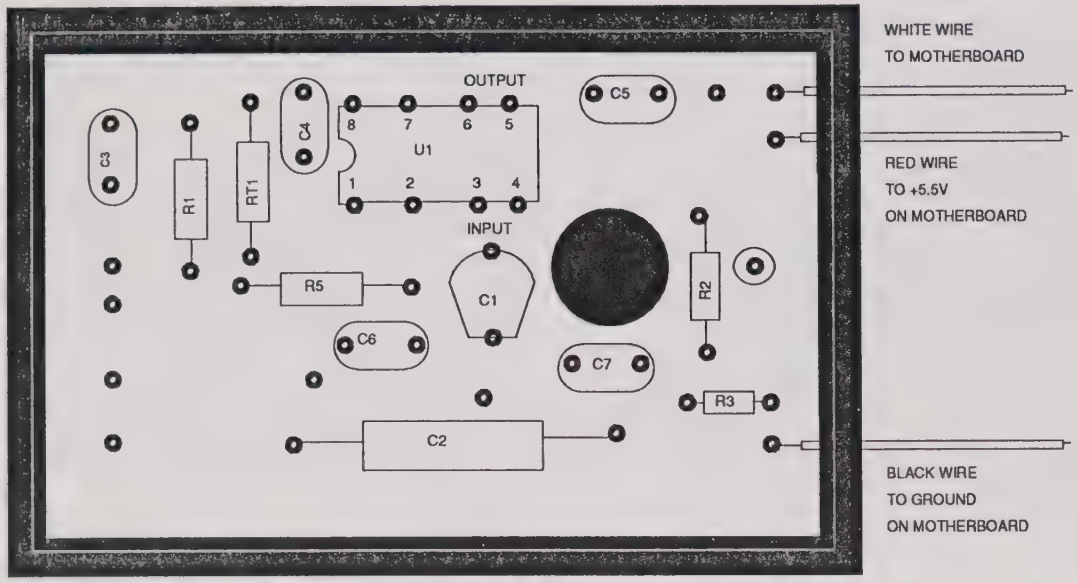


L/R OUTPUT JB-5
CHANNEL "A"

REF. OUTPUT JB-6
1.1 VPP. CHANNEL "B".

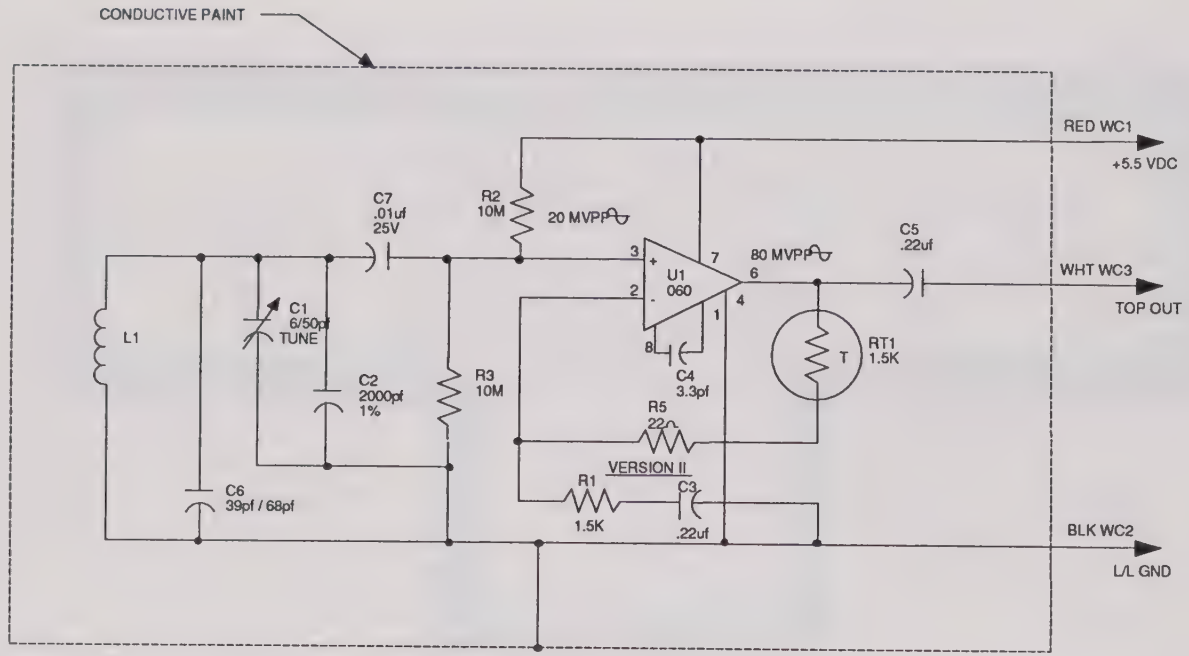
REFERENCE & L/R SENSOR OUTPUT
CALIBRATION

Fig. 20



TOP PRINTED CIRCUIT BOARD

Fig. 21

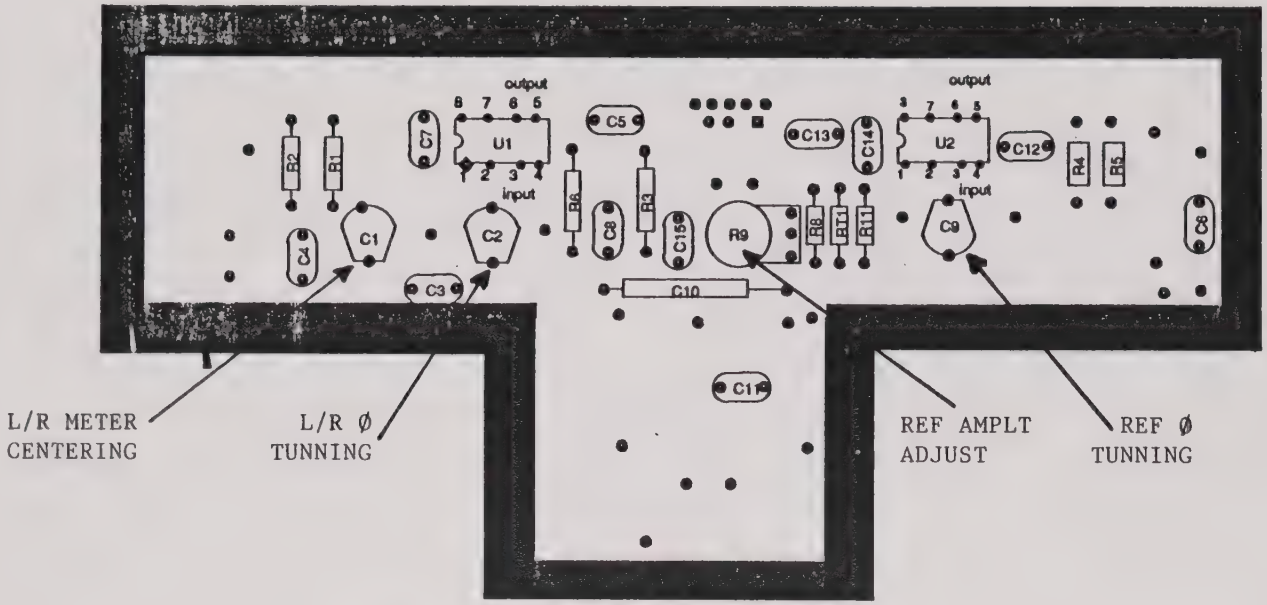


NOTES:

1. ALL RESISTORS 1/4 W. 5%
2. L1 LOCATED OFF BOARD.
3. VOLTAGES PRESENT WHEN THE SENSOR HAS +5.5 VDC AND PLACED ON THE UNIFORM MAGNETIC FIELD GENERATOR AND ENERGIZED BY AN 810 TRANSMITTER
4. R5 WILL NOT BE IN VERSION I BOARDS.
5. ALL CAPS IN MF UNLESS NOTED

SCHEMATIC, R-810 TOP PREAMP
(VERSION I & II)

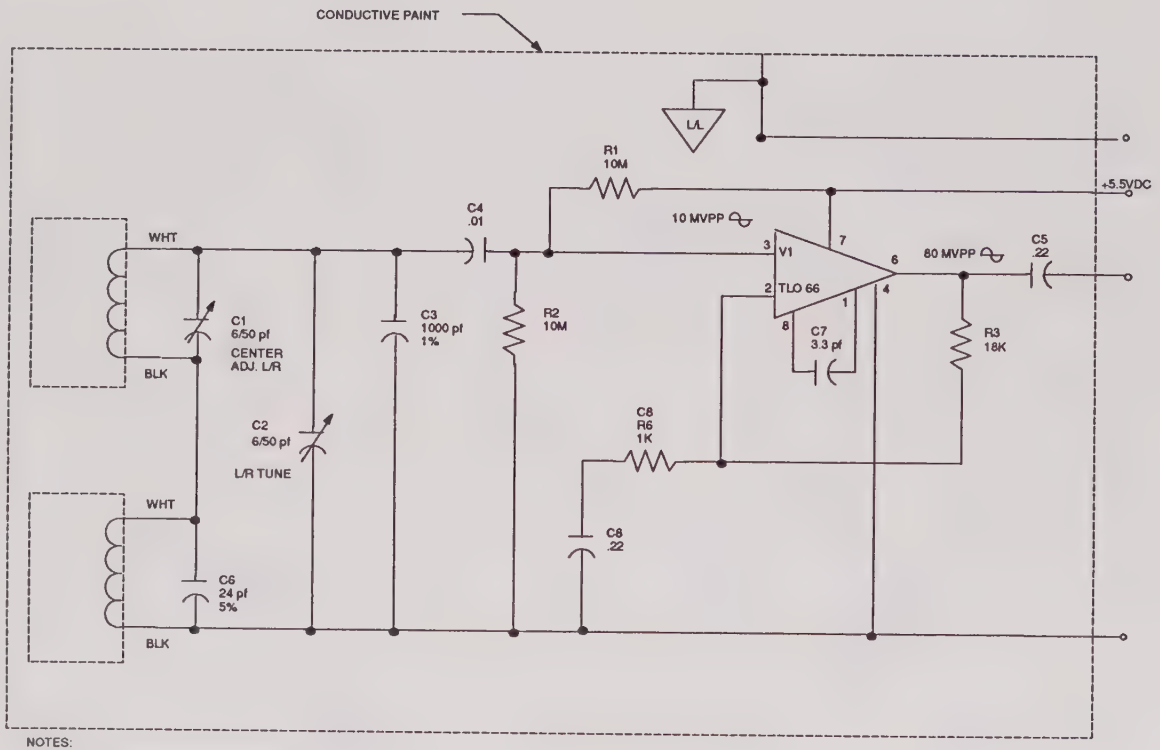
Fig. 22



REFERENCE & L/R PRINTED CIRCUIT BOARD

CURRENT STYLE

Fig. 23



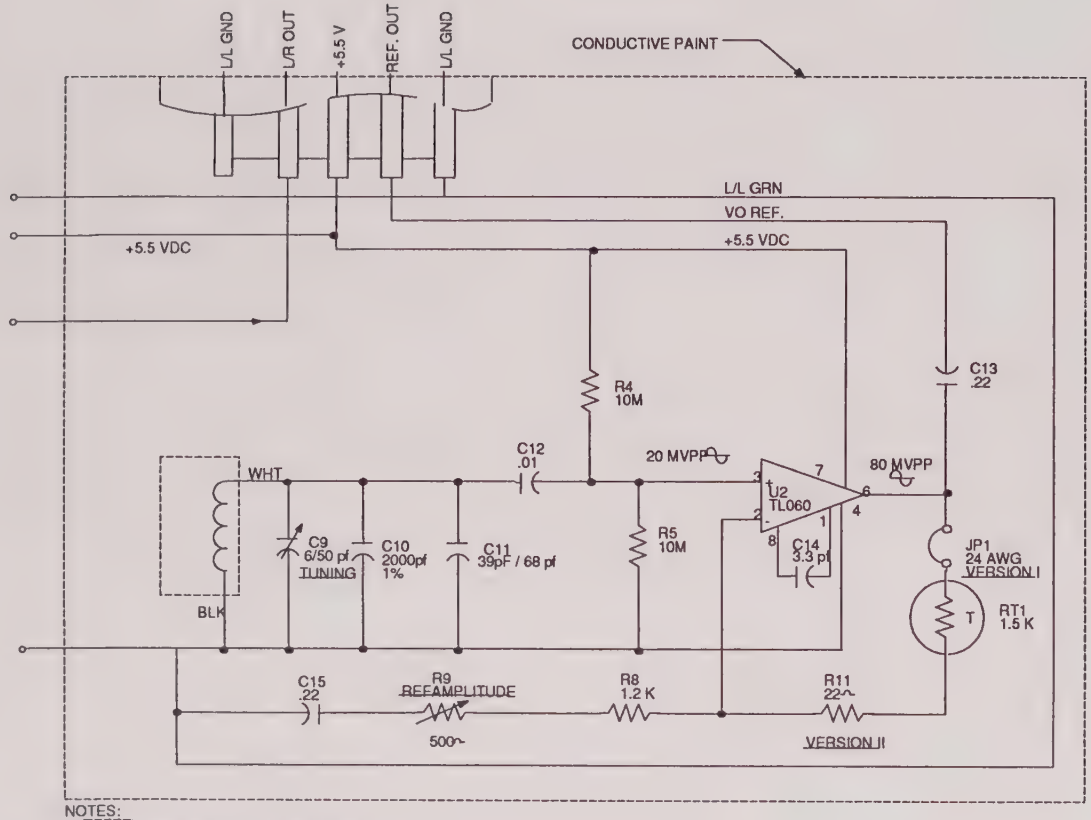
NOTES:

1. [- - -] PARTS LOCATED OFF BOARD.
2. VOLTAGES PRESENT WHEN A SENSOR PLACED ON A UNIFORM MAGNETIC FIELD GENERATOR WITH +5.5 VDC APPLIED AND ENERGIZED BY A 810 TRANSMITTER
3. ALL CAPS IN MF UNLESS NOTED

SCHEMATIC, R-810 PREAMP

Sheet 1 of 2

Fig. 24



NOTES:

1. [ ] PARTS LOCATED OFF BOARD.
2. VOLTAGES PRESENT WHEN A SENSOR PLACED ON A UNIFORM MAGNETIC FIELD GENERATOR WITH +5.5 VDC APPLIED AND ENERGIZED BY A 810 TRANSMITTER
3. ALL CAPS IN uf UNLESS NOTED

SHEET 2 OF 2

SCHEMATIC, R-810 REF. PREAMP

Fig. 24

AUXILIARY CALIBRATION PROCEDURE

This procedure should be performed when the instrument requires calibration, a sub-assembly has been replaced or right after the alignment procedure on the Uniform Magnetic Field Generator.

1.Take off the Receiver cover by removing two small phillips-head screws and pull open the battery access cover.

2.Install the Test Cover (300B038), only one screw is necessary to hold it in place and close the battery access door.

3. Connect the Receiver and Test Box (300B047) together by means of the Auxiliary Cable (300A046). Insert the cable end labeled "R" into the "Aux" input of the Receiver and the cable end labeled "T" into the transmitter output jack and turn on transmitter.

4.Place transmitter and Receiver as far apart as the cable allows and turn on transmitter.

5. Set the Receiver control switch to the "Aux" position.

6.The Receiver display should indicate a reading of 450 if not; adjust the "AUX LO" control for a reading of 450. (Fig. 19.)

7.Remove "Aux Cable".

8.Set Receiver and Transmitter about 2 feet apart as shown in Fig. 8.

9. Now adjust the "AUX HI" control for a reading of 975. See Fig. 19.

Note: *Some early model 810 Receivers do not have an 'AUX HI' control, or the control is on the rear of the Audio/AGC module. Lack of this control does not impair the operation of the unit. When operating close to the Transmitter you may get numbers on the display above 999 at which time the LCD will roll over to 000 and continue to increase.*

DEPTH CALIBRATION

Upon completion of receiver tuning on the uniform magnetic field generator, the following procedure is to be followed to calibrate the depth function:

Equipment Required

1. Properly energized test field
2. 10' wooden ladder or stairs
3. Small slotted screwdriver.

Note: *Depth calibrations should NEVER be performed in the inductive mode in that erroneous readings may result.*

1. Remove the receiver cover by removing the 2 phillips screws and pulling the nylatch on the battery access door. Install test cover (part number 300B038) and install 1 phillips screw and reinstall battery access door. Set the "low Depth" adjustment to a fully counter-clockwise position (see figure 19).

2. Position the receiver directly over the conductor and obtain a centerline condition (fig. 23). Depress and release the depth button and observe that the depth indicates the actual depth.

3. If the depth is not accurate, turn the "low Depth" pot slowly clockwise until the actual depth is acquired. Always check the depth twice before proceeding to the next adjustment.

4. Place the receiver on the wooden stairs or ladder so the receiver is a minimum of 48" from the test conductor (fig. 25)Adjust the "depth scale factor" pot to approximately the 10 0'clock position. Depress and release the depth button and observe the depth reading. If the actual depth is not obtained, adjust the "high depth" pot on the computer board (see figure 19) and recheck the depth indication.

Note: *The depth scale factor adjustment will affect the low and high depth. If the accurate depth cannot be obtained in the high or low positions, adjust the depth scale and recheck. It will be necessary to adjust the high and low adjustments after the depth scale has been adjusted. After adjustments are made, check that the low and high depths are accurate.*

5. Install the original receiver cover and recheck depths.

6. If the correct depths are not achieved using this procedure, recheck tuning accuracy on the uniform magnetic field generator. If the receiver tuning is correct, refer to the receiver troubleshooting chart on page 16.

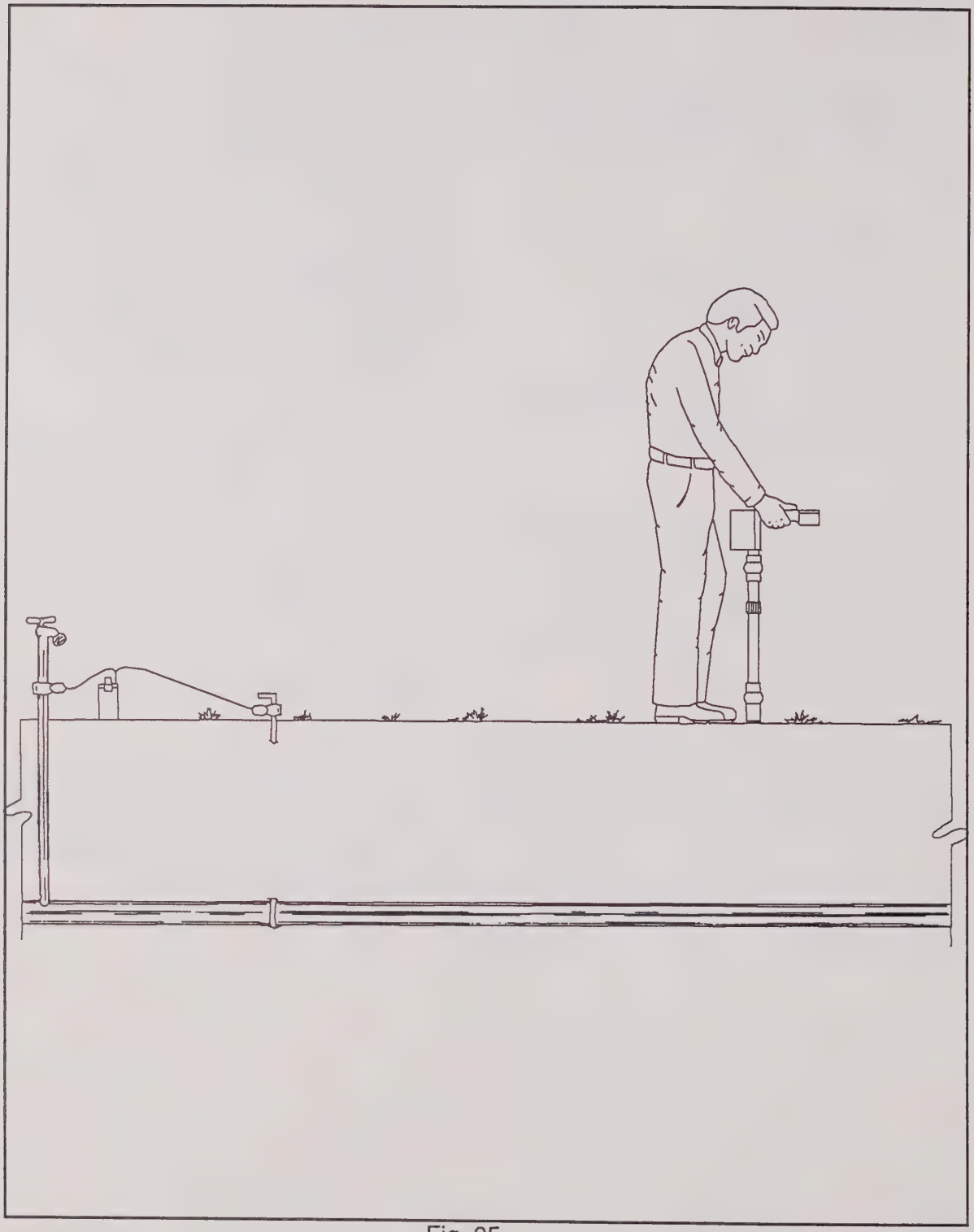


Fig. 25

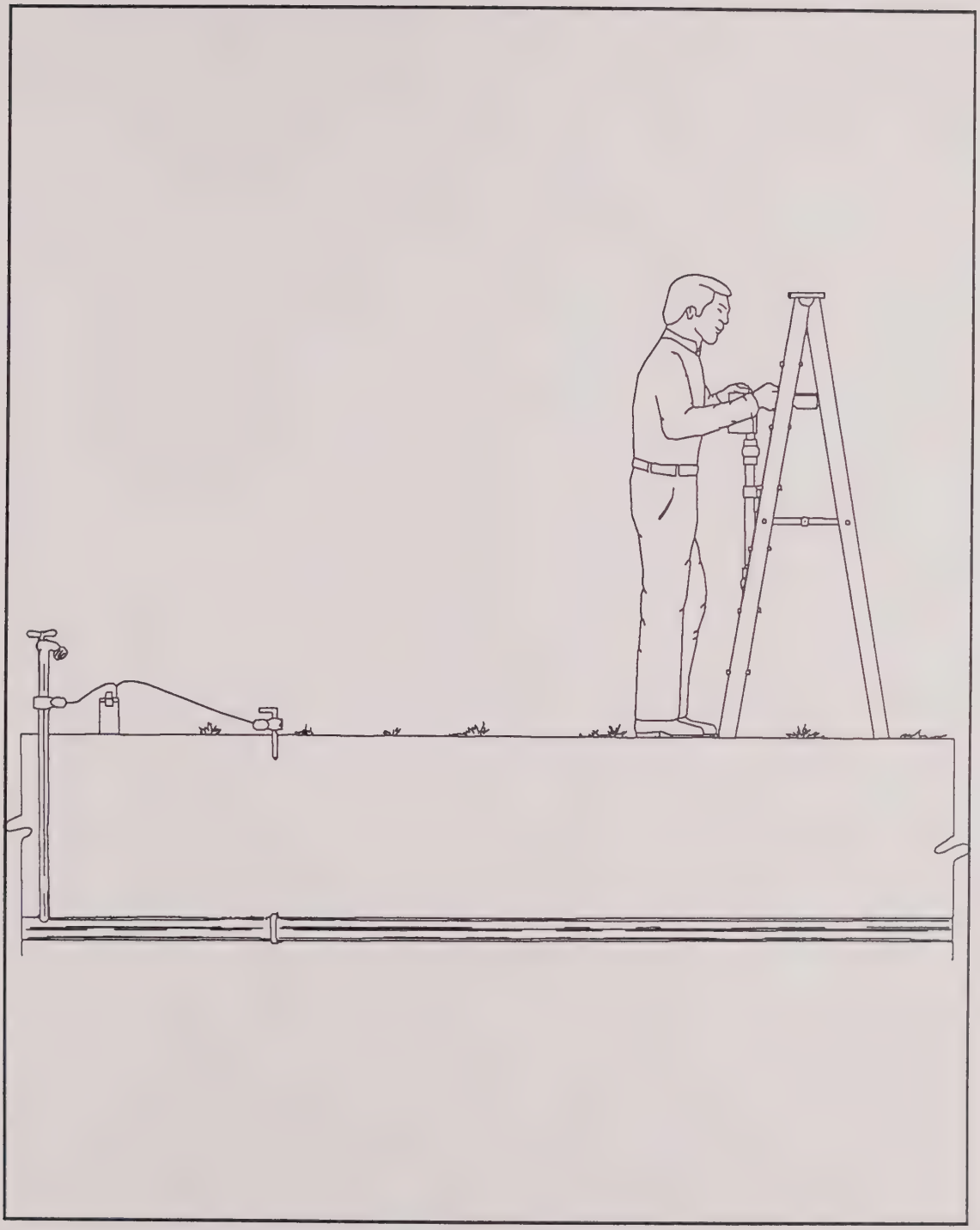


Fig. 25

4820 METROCLAMP ADJUSTMENT

Refer to figure 5

Tools Required:

1/4 inch nutdriver; phillips screwdriver, .007-inch feeler gauge.

1. Slightly loosen the 1/4 nut and the phillips screw at the pivotpoint of the clamp.

2. Ensure that the four contact surfaces are free of grease, dirt, etc..

3. Place the feeler gauge between the rear contact points and fully close the clamp.

4. Tighten the hex nut and the phillips screw so that they are snug.

5. Check the gap with the feeler gauge.

Note: It may be necessary to loosen the hex nut slightly to allow the clamp to open and spring closed. If a feeler gauge is not available, a standard business card may be used to set the gap.

RECEIVER ANTENNA HOUSING OPENING AND SEALING PROCEDURE

There are 2 types of receiver antenna housings Version 1 and Version 2. There are 2 processes for opening and sealing the 2 types of housings. The first applies to those units produced prior to June 1986 (serial numbers 796 and below). The second process refers to those units produced after June 1986 (serial numbers 797 and up.

Tools Required

1. Ice Pick
2. Exacto Knife
3. Phillips Screwdriver #1
4. Phillips Screwdriver #2
5. Slotted Screwdriver
6. Soldering Iron
7. Q-tip Applicators
8. Silicon RTV # 118

VERSION I REMOVAL AND INSTALLATION

Housing Removal

1. Place the receiver unit into uniform magnetic field generator.

2. Remove plastic filler plates covering tuning holes and screws with an ice pick by placing point of ice pick on cover at an angle and tapping handle soundly to puncture plate and pry off. Use caution to avoid personal injury.

3. Remove slot head screws securing upper housing to lower hosing. Lift off housing by prying between housing and stem.

4. Slowly raise housing being careful not to break housing ground wire. Desolder ground wire if necessary.

Housing Installation

1. Resolder housing ground wire if disconnected. Seat housing into place and check that it is flush around the entire housing.

2. Reinstall the slot head screws and tighten hand tight.

3. Retune if necessary.

4. With Q-tip apply RTV 118 around the entire area where housing halves meet being sure that there are no area where water may leak into housings.

5. Apply a small amount of RTV 118 to tuning and screw holes.

6. Install plastic filler plates and wipe off excess RTV.

VERSION II REMOVAL AND INSTALLATION

Housing Removal

1. Place the receiver unit into uniform magnetic field generator.

2. Remove plastic filler plates covering tuning and screw holes with an ice pick by placing the point of the ice pick on cover at an angle and tapping soundly to puncture plate and pry off. Use caution to avoid personal injury.

3. Remove screws securing upper housing to lower housing. Pry between housing gently and lift off slowly being careful not break housing ground wire. Desolder ground wire if necessary.

Housing Installation

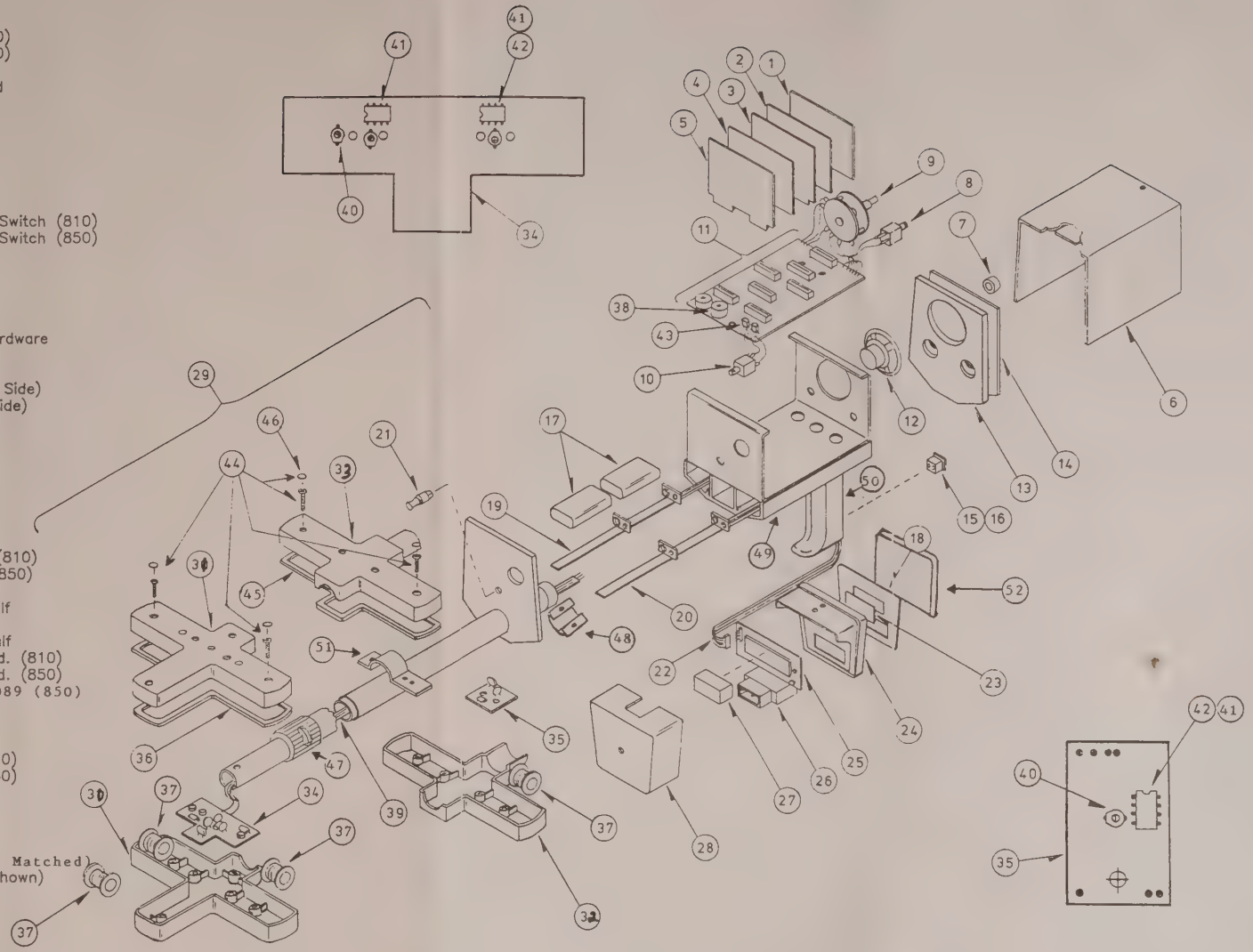
1. Removal residual gasket material from housing halves. Inspect old gasket checking usability. If not, remove paper backing from a new gasket and apply to one housing half being sure that gasket is flush to housing around the entire housing edge. Remove paper backing on other side of gasket.

2. Resolder ground wire if previously removed. Seat housing in place and check that gasket is flush around housing edge.

3. Install screws in same locations and check tuning and retune if necessary.

4. With a Q-tip apply a small amount of RTV 118 to tuning and screw holes and insert plastic filler plates. Wipe off excess RTV.

51.	500A375	Brkt. Magnetic Field
52.	500B241	Rain Cover
1.	500B018	Detector/Meter Board (810)
	400B056	Detector/Meter Board (850)
2.	500B045	Audio/AGC Board
3.	500B046	Sequencer/Regulator Board
4.	500B016	Computer Board
5.	400B054	Amplifier Board
6.	400B047	Receiver Cover with Pad
7.	112600	Receiver Knob
8.	162428	Headphone Jack
9.	500A043	Rotary Switch
10.	162427	AUX Jack
11.	400C058	Mother Bd. with Jacks & Switch (810)
	400C061	Mother Bd. with Jacks & Switch (850)
12.	500A024	Speaker
13.	500C008-1	Front Molded Panel
14.	500A412	Front Panel Decal (810)
	500A411	Front Panel Decal (850)
15.	162541	Depth Button
16.	162542	Depth Button Mounting Hardware
17.	162437	Battery, 9V Alkaline
18.	500A244	Display Decal
19.	400B091	Battery Connector (Switch Side)
20.	400B090	Battery Connector (Jack Side)
21.	112535	Battery Door Latch
22.	400A008	Display Cable
23.	500A057	LCD Window
24.	500A148	Display Bezel
25.	400B053	Display Module LCD
26.	162442	Left/Right Meter
27.	500A248	Foam Block
28.	500B013	Diaplay Cover
29.	400C100	Receiver Stem, Complete (810)
	400C101	Reciever Stem, Complete (850)
30.	400C094-1	Lower Housing, Top Half
31.	400C094-2	Lower Housing, Bottom Half
32.	400C093-1	Upper Housing, Top Half
33.	400C093-2	Upper Housing, Bottom Half
34.	400C086	Left/Right-Ref. Preamp Bd. (810)
	400C088	Left/Right-Ref. Preamp Bd. (850)
35.	400C087	Top Preamp(810) 400C089 (850)
36.	500D033	Housing Gasket, Lower
37.	500A186	Sensor Coil (810)
	500A188	Sensor Coil (850)
38.	500B131	Interstage Transformer (810)
	500C032	Interstage Transformer (850)
39.	500A045	Coil Cord
40.	172016	Trim Cap 5-60pF
41.	154040	I.C. TL060CP
42.	154056	I.C. TL080CP (810 Only)
43	152124-X	Transistor 2N5485 (Q4,Q5 Matched)
44.	800A028	Stem Hardware Kit (Not Shown)
45.	500D034	Housing Gasket, Upper
46.	500A292	Cap
47.	500B052	Stem Lock Nut
48.	500A176	Stem Ret. Clip
49.	400B027	Main Base
50.	500A087	Handle



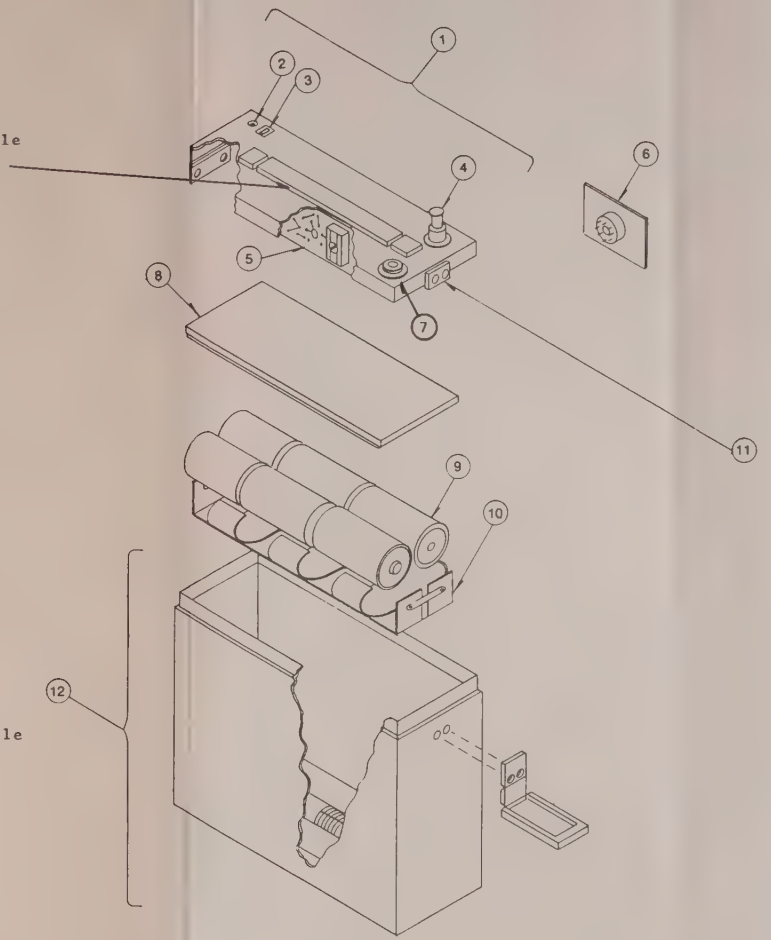


Figure 15 Transmitter Illustrated Parts Breakdown.

PREVENTATIVE MAINTAINANCE

Listed below are some helpful hints in maintaining the Model 810 Line Tracer:

1. When possible, check the field strength, depth, and left/right functions on a "Known Conductor" to ensure proper operation and calibration.

2. Keep the unit clean and avoid getting dust or dirt in the output jacks, switches and speaker which could cause a performance problem. Wipe the unit with a damp cloth on a regular basis.

3. When locating in the rain or damp environment, place the receiver in a plastic bag (or waterproof cover). The transmitter can be placed in the carrying case with the lid closed but not latched.

4. If the unit should get wet, dry it as soon as possible by opening the covers and air drying the circuits. Place a drop of oil on the shaft of the transmitter on/off switch.

5. Keep the 4820 Metroclamp free of dust and dirt. Check the air gap at the pivot point of the clamp.

6. Avoid disconnecting the accessories by pulling the cables. This causes the connections in the plugs to break.

7. Do not use the carrying case as a catch all; items such as paint cans, ground rods, etc. may cause damage to the unit.

8. Check the clamp and conductive attachment for frayed or broken wires.

9. Consult the Operator's Manual for correct operating instructions and application tips.

10. Change the transmitter and receiver batteries on a regular basis using batteries recommended by the manufacturer.

11. If there are questions about operation, application, or repair, contact **Metrotech Customer Service 1-800-638-7682.**

A GENERIC APPROACH TO CABLE AND PIPE LOCATING

By Phil Webber

The majority of pipe and cable locators in use today employ the use of radio or audio frequency as a means of applying signal or tone to underground utilities. These instruments generate an active signal onto the pipe or cable by means of a transmitter or tone generator. This signal may be applied by various methods, the first being the conductive or direct mode where there is access to a contact point such as a valve or a cable sheath. Another is the inductive or indirect mode, whereby the transmitter and antenna is placed on the surface of the ground above the conductor and the signal is induced through earth onto the pipe or cable.

One other popular method is the use of an inductive coupler where signal can be applied to a cable without lifting bonds or disrupting service. The coupler induces a strong electro-magnetic field onto the cable and aids in isolating specific conductors. Once signal is properly applied, it is then traced by the use of a receiver unit. These will vary according to manufacturer as far as size, antenna configuration, types of controls, etc. However, regardless of make, there are some basic operating procedures that apply to all models.

To begin with, the user must think of the pipe or cable as a conductor and part of a circuit that must be complete to allow signal flow. The ability of the conductor to carry signal is very important, and this is determined by its composition. For example, copper is an excellent conductor, as is aluminum. Steel is less conductive, and one of the poorest is cast iron. These are the most common materials used for underground utilities.

If any of these conductors are coated, wrapped or insulated, the signal will not bleed off into the surrounding soil as rapidly as it does with a bare conductor. Hence, the conductor can be traced further before the transmitter must be moved to a new location and reconnected. Also, insulated conductors are not as easily influenced by their environment, such as poor soil conditions. Size of the conductor is also a factor. A given signal cannot travel as far on large diameter pipe as it can on a small insulated cable. The other part of the circuit is the

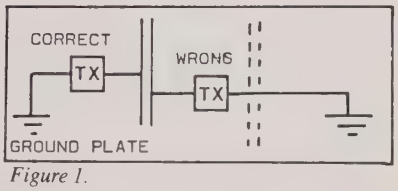


Figure 1.

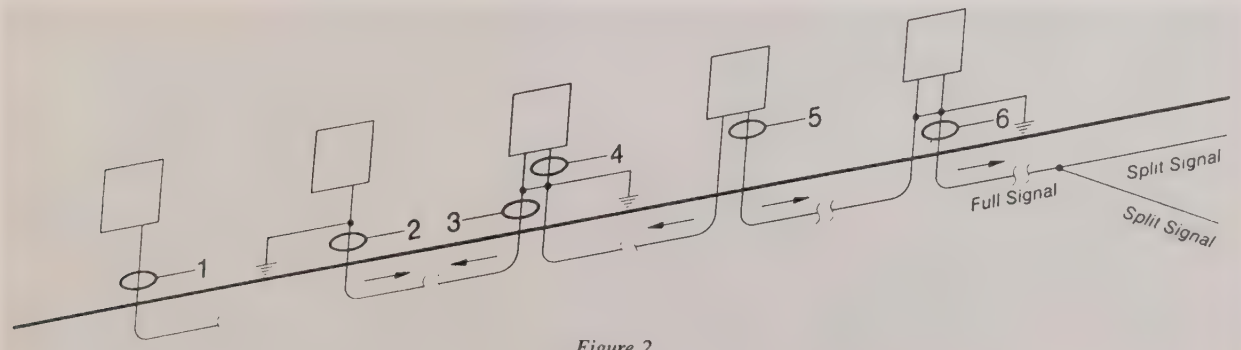


Figure 2.

1. The Metroclamp can be used in all trace applications where conductors are exposed at one or more places. The only exception is at a terminated end that is an open circuit.
2. Coupling transmitter clamp to a terminating point of a trace item requires a grounded conductor to provide proper current flow through the ground.
3. Always couple to a conductor between the ground and the point where the conductor enters earth.
4. Incorrect coupling; trace signal will return to ground.
5. Coupling around a long conductor feeding in two directions creates a current flow allowing trace in both directions.
6. Coupling to a conductor with drop lines or laterals feeds full trace signal up to the junction point and then divides the signal strength into each branch.

CABLE LOCATING

soil surrounding the conductor. The ability of soil to pass current will vary locally. Wet compact soil is clearly a better conductor than loose sandy soil or frozen ground. Moist soil produces a better tracing environment than dry or frozen ground.

Conductive vs. Inductive Uses

As mentioned before, this mode requires direct contact with a conductor. An independent ground must be established to provide a return circuit path. Proper use of the transmitter and ground rod or plate cannot be over emphasized.

It can be safely said that at least 80 percent of all application problems results from failure to properly energize the target conductor. For example, if the ground lead wire is placed nearby, or over a nearby utility, it can cause confusing tracing signals as the lead itself radiates as much signal as the target conductor (see Figure 1). In many urban areas where exposed ground is not available, the use of a ground plate is recommended. To establish a good ground on cement or asphalt, you must provide a combination of surface contact, moisture and weight.

The inductive method is probably the easiest and most convenient way to use a locator. However, if not done properly, it can lead to serious tracing errors. Where direct contact is not possible, the transmitter is placed on the ground directly above the conductor and the signal is induced through earth onto the target. The conductor then becomes a secondary transmitter and rebroadcasts the signal to the receiver unit.

There are many different antenna designs for transmitters, which in turn influences the direction the transmitter must be placed in relationship to the target conductor. Also one must determine the minimum distance the receiver may be used from the transmitter. Air coupling effects can cause erroneous readings if the receiver is too close to the transmitter. The inductive mode generally has a shorter tracing range, especially on conductors at depths over 36 inches. One must also remember that the transmitted signal can be easily induced into other nearby utilities, especially if they are better conductors and at shallower depths.

Design and sizes of inductive couplers will vary with each manufacturer, but they all apply signal basically in the same manner. A tracing signal is induced on the target conductor by an electromagnetic field created by the coupler. The coupler does not make direct contact as in the conductive method, but surrounds the conductor like a current measuring clamp. This method eliminates air coupling and greatly improves isolation of specific conductors.

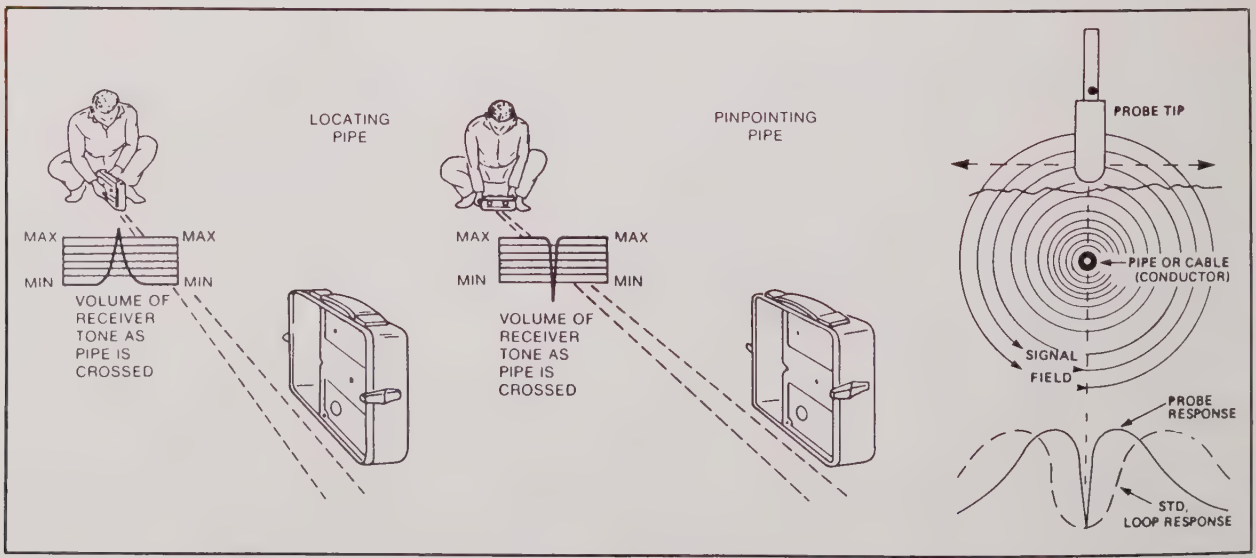
When using a coupler, the conductor must be grounded at both ends for a complete circuit path. Insulated coupling on gas meters must be bypassed to complete the circuit. Also care must be taken not to position the coupler above an electrical grounding point, as the signal will seek the path of least resistance and return to ground and not onto the conductor (see sidebar and Figure 2).

Types of Receivers

There is a noticeable difference between manufacturers when it comes to receivers. Antenna or loop designs will vary greatly. Some are rigid and attached to the outside of the receiver case. Others, called multi-turn loop antennas, are mounted on the inside. A more recent design is the use of search coils in place of the broad loop antennas. In all instances, close attention must be given to the angle of the antennas or search coils in relationship to the conductor. The antenna must be maintained at the proper angle to receive the best signal from the conductor.

Most receivers operate in a peak or null mode. Peak mode is when the antenna receives maximum signal over the conductor. Null mode is when the antenna receives minimum signal over the conductor. Peak and null modes are usually determined by the vertical or horizontal position of the antenna (see Figures 3 and 4). Generally, the peak or maximum mode is used for tracing and

Phil Webber is Applications Engineer for Metrotech Corp., Mountain View, Calif.



Figures 3 and 4 (left and center). Peak and null modes are usually determined by the vertical or horizontal position of the antenna. Generally the peak or maximum mode is used for tracing and the null for pinpointing the centerline of the conductor. Figure 5 (right). An even more advanced locator design is the twin coil antenna. This design allows a narrower response to the conductor and is very beneficial to the user locating in congested areas.

the null for pinpointing the center line of the conductor. However, the user's preference generally determines the method used.

Obviously, an antenna produces a more accurate and stronger response when it is as close as possible to the target conductor. Therefore, an extended search coil is an advantage to the user, allowing him maximum tracing signal from a standing, upright position (see Figure 5). An even more advanced design is the twin coil and antenna. This allows a narrower response to the conductor and is very beneficial to the user locating in congested areas.

Another common feature is sensitivity or gain controls. These controls are used to adjust the amount of signal received from the conductor and transmitter. Receiver sensitivity must be continually and properly adjusted to prevent tracing errors. This feature has been eliminated on some models and replaced with automatic gain control. With this feature the user need not make any adjustments. Automatic gain control allows the receiver to respond to other conductors also, which will help the user develop a clearer picture when solving locating problems in congested areas.

In addition to automatic gain control, there are other new features available, such as a digital readout for measuring the relative field or signal strength on a given conductor. This is an important tool which can aid the user in identifying a specific target.

Depth Estimating

There are occasions when an estimation of depth is required without exposing the conductor. This can be accomplished by using various methods. The most common in past years has been the triangulation method, where the receiver loop is tilted at a 45 degree angle to the conductor and moved away from the centerline until a null is obtained. Then, using a simple geometric formula, the approximate depth can be determined (see Figure 6).

Variations of this include the use of extension probes with built-in depth levels (see Figure 7) or simply lifting the receiver loop straight up over the conductor and measuring the height. Of course the accuracy of these methods can be affected by any one of the following conditions: nearby metallic structures, extreme changes in ground conductivity, low signal strength or signal in nearby conductors.

There are more recent designs such as the twin coil antenna and push button digital depth readout that lessens these effects. However, regardless of make or design, there is not one locator that can magically outsmart all the laws of physics and be 100 percent accurate under all conditions.

Frequencies Used

To date, the most widely used frequencies are in the high radio frequency (R.F.) ranges. An advantage of R.F. is that it is generally easier to apply to a conductor, such as with inductive use. Also the signal can travel, although limited, across small insulators or gaskets commonly used in distribution systems.

There are several disadvantages of R.F. The power output of the transmitter cannot be too high, as R.F. signals can be easily coupled into other nearby conductors. Also on good conductors, R.F. signals cannot be traced as far as lower frequency audio signals (A.F.). Another advantage of the lower audio frequencies is that the applied signal does not bleed off as easily, allowing better isolation. With some audio frequency locators, the user has an option of high output transmitters, ranging as high as 500 watts, which are useful for long range tracing on cable or gas transmission lines.

A disadvantage of audio is that if there are any insulators or gaskets on a conductor, such as on a water or gas line, the signal will not continue. Another is that A.F. signals are not as easily induced onto a conductor as R.F. and therefore are not as efficient in the inductive mode. Also when applying audio to a conductor, good grounding is essential for maximum signal strength.

Summary

For years, even decades, the evolution of pipe and cable locators has been very gradual. Now with the ever-increasing density of underground plant and structures, the need for more advanced locating equipment has become quite clear. There are locators available today to help meet that need with automatic features, digital readouts and audio guidance, which combined provide new speed, shortened training requirements plus accuracy and convenience for the user.

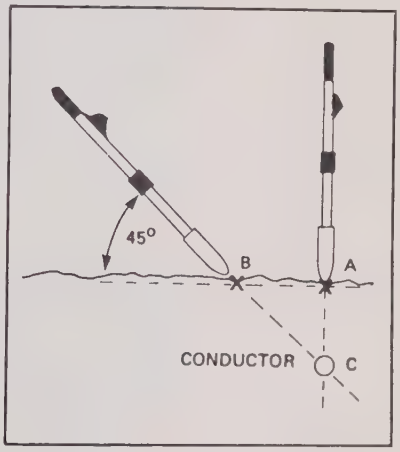


Figure 7. A variation of the triangulation method includes the use of extension probes with built-in depth levels or simply lifting the receiver loop straight up over the conductor and measuring the height.

Not mentioned in the preceding paragraphs are other types of instruments, such as magnetic locators used for locating discrete ferrous structures, passive

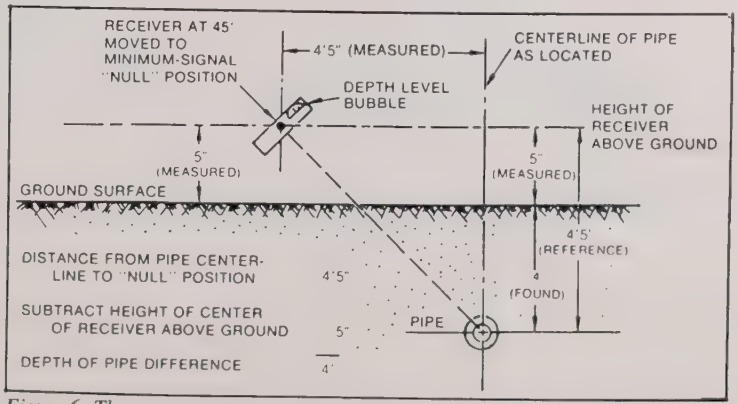
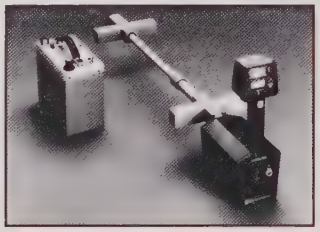


Figure 6. The most common method to estimate depth is the triangulation method, where the receiver loop is tilted at a 45 degree angle to the conductor and moved away from the centerline until a null is obtained. Using a simple geometric formula, the approximate depth can be determined.

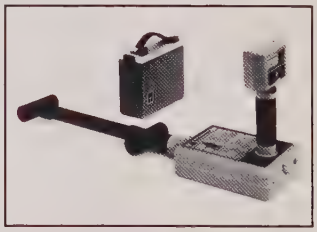
locators that will trace 60 HZ AC, detachable transmitters for finding sewer service lines and electronic marker systems that are tuned for specific utilities, only to name a few.

When choosing a locator, one must consider versatility and training requirements. With today's congestion, it is a must for the user to be aware of other utilities and conductors in the area to help him solve the really tough jobs. As stated many times before, pipe and cable locating is not an exact science. It requires the experience, knowledge of construction practices and confidence in your instrument.

METROTECH - Problem Solvers

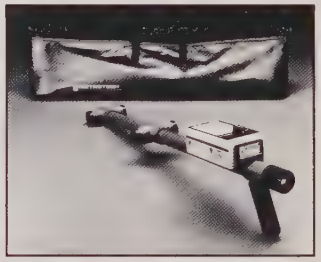


850 and 810 Line Tracers—feature automatic directional guidance system, push button depth measurement, and upright operation. 850 Audio Frequency with high power transmitter for long distance tracing and excellent isolation of conductors in highly congested areas. 810 Radio Frequency jumps insulators and gaskets present on water and gas distribution lines.



650 and 610 Passive/Active Locators—feature three selectable tracing modes—Active (650–9.8kHz Audio Frequency, 610–39kHz Radio Frequency), Power (50/60Hz), and Radio (14–22kHz); five selectable transmitter load matching positions, line-of-sight display, upright operating position, and pushbutton depth measurement capability. Easy to use, lightweight, and weatherproof.

480 Pipe and Cable Locator—Versatile, rugged, and low-cost. Optional Carrying Handle for blind searches. Accessories include 50/60-480 which serves as an Inductive Probe for the 480 as well as a Power Line Detector and Metroclamp.



50/60 & 50/60-480 Power Line Detector—Twin antenna design enables it to easily distinguish between overhead and underground loaded power lines. 50/60-480 doubles as an inductive probe accessory for split box locators. Line-of-sight signal strength display, depth measurement capability, and upright operation.

880 Iron and Steel Locator—for locating buried iron or steel metal objects such as valve boxes, manhole or vault covers, curb stops, etc. at greater depths than other instruments while disregarding unwanted aluminum cans, bottle caps, etc.

220 Valve Box/Pedestal Locator—easily locates valve boxes, manhole covers, meter boxes, and other metallic surfaces covered by pavement or vegetation.

METROTECH

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METROTECH SERVICE BULLETIN

Model Number	810/850
Item affected:	Receiver Antenna Housing 400B051-1 Housing, Lower Top 400B052-1 Housing, Upper Top 400B051-2 Housing, Lower Bottom 400B052-2 Housing, Upper Bottom
Effective:	Upon depletion of current stock
Reference Manuf. ECN:	296
Description:	Applying new housing type to existing units

See Attached

This bulletin applies to the following products and serial numbers ranges:

Model 810 S/N 3734-11376
Model 810M S/N 3734-10569
Model 850 S/N 215-796

SERVICE BULLETIN
MODEL 810/850 RECEIVER ANTENNA

In June, 1986 a significant change was made on the Model 810/850 Line Tracer. The change affects the receiver antenna housings, left/right preamp board and top preamp board on both models. The antenna housings were made thicker with much improved structural reinforcing. In addition a gasket is provided to be used between housing halves for further moisture resistance. The layouts were changed on the left/right and top preamps as well as the boards are now solder masked for improved reliability. Due to an engineering tooling change on antenna housings, only new style housings are being manufactured. Eventually the existing supply of regular housings will be depleted. In addition, the physical dimensions of the old boards cannot be used in the new housings. In an effort to keep repair cost down by not having to replace both housings when one is damaged, or by having to replace top and left/right boards when bottom housing are damaged, the following steps have been taken:

1. New style housings have been modified to accept old style boards (400B106 and 400B043).
2. Step by step procedures are attached to apply an old style housing half with a new half for each of the (4) antenna housing positions.
3. A part number cross reference is attached to minimize error.

Part Number Cross Reference

OLD		NEW
400B051-1	Housing, Lower Top	400C109-1
400B051-2	Housing, Lower Bottom	400C109-2
400B052-1	Housing, Upper Top	400C108-1
400b052-2	Housing, Upper Bottom	400C108-2

The 500 series part numbered housings are special housings to accommodate old style boards. Additional Part Number Substitutions are as follows:

OLD		NEW
400B106	Assy, PCB Preamp Ref/Left Right Ant 810A	400C086
400B043	Assy, PCB Preamp Upper Ant 810A	400C087
400C029	Assy, Antenna Tuned and Tested 810A	400C100
400C028	Assy, Antenna Tuned and Tested 850	400C101
400B120	Assy, PCB Preamp Left/Right 850	400C088
400B121	Assy, PCB Preamp Top 850	400C089

INSTALLATION PROCEDURE

New Style Lower Top Housing (P/N 400C109-1) onto Old Style Lower Bottom (P/N 400B051-2)

On a secure bench or table top with tools and material (see Fig. 1 & Fig. 2) at hand; remove existing lower top housing P/N 400B051-1 by the following steps:

A. With ice pick - pop out plastic buttons covering the screws
B. Remove screws.
C. Lift off housing; use caution when prying between housing and stem.
D. Desolder housing ground wire from, left/right preamp PCB.

Install P/N 400C109-1 by the following steps:

F. Put new gasket (P/N 500D033) on existing housing.
G. Remove remaining paper backing on gasket.
H. Remove rubber bumper from existing housing and cut in half.
I. Install one half bumper on to old style housing.
J. Seat in place replacement housing, and resolder ground wire to left/right PCB.
K. Install screws in the same location as before with exception of the four screws closest to the aluminum stem assy. Cover these holes and seal with RTV.
L. If alignment of reference or L/R signals required, do it at this time, then proceed with step M.
M. With Q-tip, apply a small quantity of silicon RTV 118 to holes screw and alignment holes.
N. Insert plastic buttons.
O. Wipe off excess silicon.

New Style Upper Top (P/N 400C108-1) onto Old Style Upper Bottom (400B052-2)

On a secure bench or table top with tools and materials (see Fig. 1 & Fig 2) at hand; remove existing housing P/N 400B052-2 by the following steps:

A. With ice pick - pop out plastic buttons covering the screws.
B. Remove screws.
C. Lift off housing; use caution when prying between housing and stem.
D. Desolder housing ground wire from top preamp PCB.

Install top housing P/N 400C108-1 by the following steps:

F. Put new gasket on existing housing.
G. Remove remaining paper backing on gasket.
H. Seat in place replacement housing and resolder housing ground wire to top preamp PCB.
I. Install screws in same location. Retune if necessary.
J. With Q-tip, apply a small quantity of silicon RTV 118 to holes with screws

K. Insert plastic buttons.
L. Wipe off excess silicon.

New Style Lower Bottom Housing (P/N 400C109-2) onto Old Style Lower Top Housing (P/N 400B051-1)

On a secure bench or table top with tools and materials (see Fig. 1 & Fig. 2) at hand; remove existing reference housing P/N 400B051-2 by the following steps:

A. With ice pick - pop out plastic buttons covering the screws.
B. Remove screws
C. Lift off housing; use caution when prying between housing and stem.
D. Scrap off existing silicon around top perimeter of existing housing.
E. Desolder housing ground wire from L/R preamp PCB.

Install new reference housing P/N 400C109-2 by the following steps:

F. Put gasket (P/N 500D033) on replacement housing.
G. Remove rubber bumper and cut in half.
H. Install one half of rubber bumper on to existing housing.
I. Remove paper backing on gasket.
J. Seat replacement housing in place and resolder ground wire to L/R PCB.
K. Install screws in the same location as before with exception of the four screws closest to the aluminum stem nut on stem assy.
L. If alignment of reference or L/R signal required, do it at this time, then proceed to step M.
M. With Q-tip, apply a little bit of silicon RTV 118 to holes with screws and to side of holes
where there are no screws.
N. Insert plastic buttons in all holes.
O. Wipe off excess silicon.

New Style Upper Bottom Housing (P/N 400C109-2) onto Old Style Upper Top Housing (P/N 400B052-1).

A. With ice pick - pop out plastic buttons covering the screw.
B. Remove screws.
C. Lift off housing; use caution when prying between housing and stem.
D. Scrape off existing silicon around top perimeter of existing top housing
E. Desolder ground wire from top preamp PCB.

Install top housing P/N 400C109-2 by the following steps:

F. Put gasket (P/N 500D033) on replacement housing.
G. Remove paper backing from gasket.
H. Seat replacement housing in place and reconnect ground wire.

I. Install screws in the same location, retune if necessary.
J. With Q-tip, apply silicon RTV 118 to holes with screws.
K. Insert plastic buttons.
L. Wipe off excess silicon.

Tools Required

Ice pick
Exacto knife
Phillips screwdriver #1
Phillips screwdriver #2
Slot screwdriver
Solder iron
Q-tip

Materials Required

Silicon RTV 118 P/N 181068
Gaskets P/N 500D033
Plastic buttons P/N 500A292
* Housings
Housing Lower top P/N 400C109-1
Housing Lower bot P/N 400C109-2
Housing Upper top P/N 400C108-1
Housing Upper Bot P/N 400C108-2

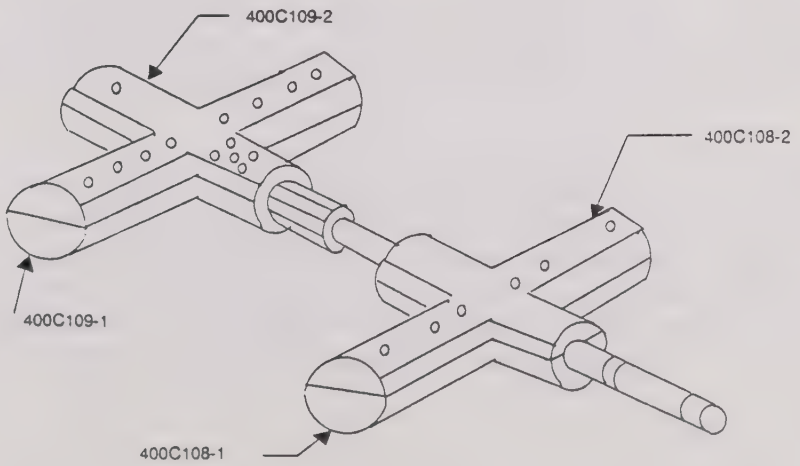
TO REPLACE THE ANTENNA HOUSING, USE THE FOLLOWING PART CROSS REFERENCE:

1. MODEL 810 S\N 3734-11376
   MODEL 810 METRIC S\N 3734-10569
   MODEL 850(ALL) S\N 215-796

WAS	IS
400B051-1	400C109-2
400B051-2	400C109-1
400B052-1	400C108-2
400B052-2	400C108-1

2. MODEL 810 S\N 11376 AND UP
   MODEL 810 METRIC S\N 10569 AND UP
   MODEL 850(ALL) S\N 796 AND UP

WAS	IS
400B051-1	400C094-1
400B051-2	400C094-2
400B052-1	400C093-1
400B052-2	400C093-2



METROTECH

670 National Avenue
Mountain View, CA 94043-9853
415/940-4900 Fax: 415/962-9527
Telex: 6502726454MCI UW

To: Model 810/850 Dealers and Distributors

From: Metrotech Technical Support

Subject: Quality Enhancement: Ruggedized Left/Right Guidance Meter

FIELD CHANGE NOTICE

FCN NUMBER 002 DATE 9/20/90 MODEL(S) EFFECTED 810/850 PAGE 1 OF 2
ECN NUMBER 659 SUB ASSY/ASSY EFFECTED 162442
APPROXIMATE CUT-IN DATE 9/25/90 SERIAL NUMBER 810 - 22000 / 850 - 5800

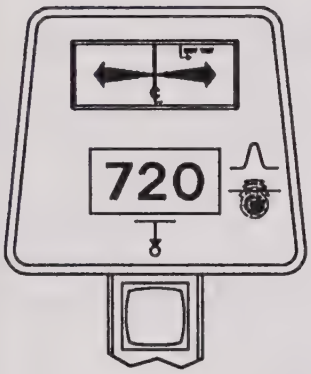
CHANGE IS:
- [x] MECHANICAL
- [ ] ELECTRICAL
- [ ] DOCUMENT

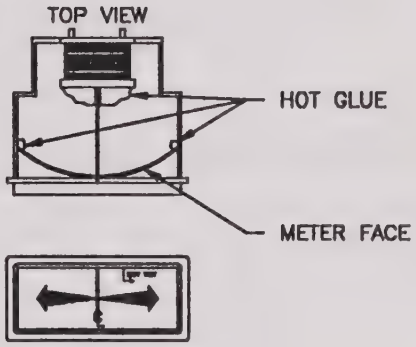
- [ ] REQUIRED
- [ ] NOT REQUIRED
- [x] NOT RECOMMENDED AS RETROFIT

RECOMMENDED ACTION:
- [ ] URGENT
- [ ] AS REQUIRED
- [ ] NEXT MAINTENANCE CALL
- [x] NONE

The Model 810/850 Receiver was designed for use in a rugged outdoor environment. Over its product life the Model 810/850 has demonstrated the ability to withstand the stress and strain of most normal operations. But any equipment is only as strong as its weakest link. The purpose of our quality enhancement effort is to raise the reliability and performance of each "weakest link" in the Metrotech product line.

One of the weak spots on the Model 810/850 was the left/right guidance meter. In order to get the correct response time we had to use a precision display meter. But, being a precision meter it was not designed to operate under the kinds of conditions encountered during field operations. Our application as a hand-held portable instrument required a meter that was not commercially available. Since the "perfect" meter was not available we decided to increase performance and reliability of the current unit by adding some "ruggedized features" of our own design.





METROTECH LEFT/RIGHT METER

Part Nu# 162442

By hot gluing in three places we are:

1 Preventing the counterweight from breaking loose and jamming the needle.

2. Strengthening the bond between the meter movement and the case.

3. Securing the meter face to the case, preventing contact with the directional needle.

We feel these added features will significantly increase the durability and shock resistance of this component.

Metrotech is committed to keeping you (our customers) informed of changes we are making to improve the quality of our products. This meter enhancement does not require any action on your part, other than to recognize our continuing efforts to meet your products needs.

Steve Hallgren
Technical Support Manager

09/20/90

METROTECH®

670 National Avenue
Mountain View, CA 94043-9853
415/940-4900 Fax: 415/962-9527
Telex: 6502726454MCI UW

To: Model 810/850 Dealers and Distributors

From: Metrotech Technical Support

Subject: Quality Enhancement: Metroclamp 4820/5120

FIELD CHANGE NOTICE

FCN NUMBER 003 DATE 10/10/90 MODEL(S) EFFECTED 810/850 PAGE 1 OF 2
ECN NUMBER 642/661 SUB ASSY/ASSY EFFECTED METROCLAMP 4820/5120
APPROXIMATE CUT-IN DATE 11/1/90 SERIAL NUMBER N/A

CHANGE IS:
- ■ MECHANICAL
- ☐ ELECTRICAL
- ☐ DOCUMENT

- ☐ REQUIRED
- ■ NOT REQUIRED
- ■ NOT RECOMMENDED AS RETROFIT

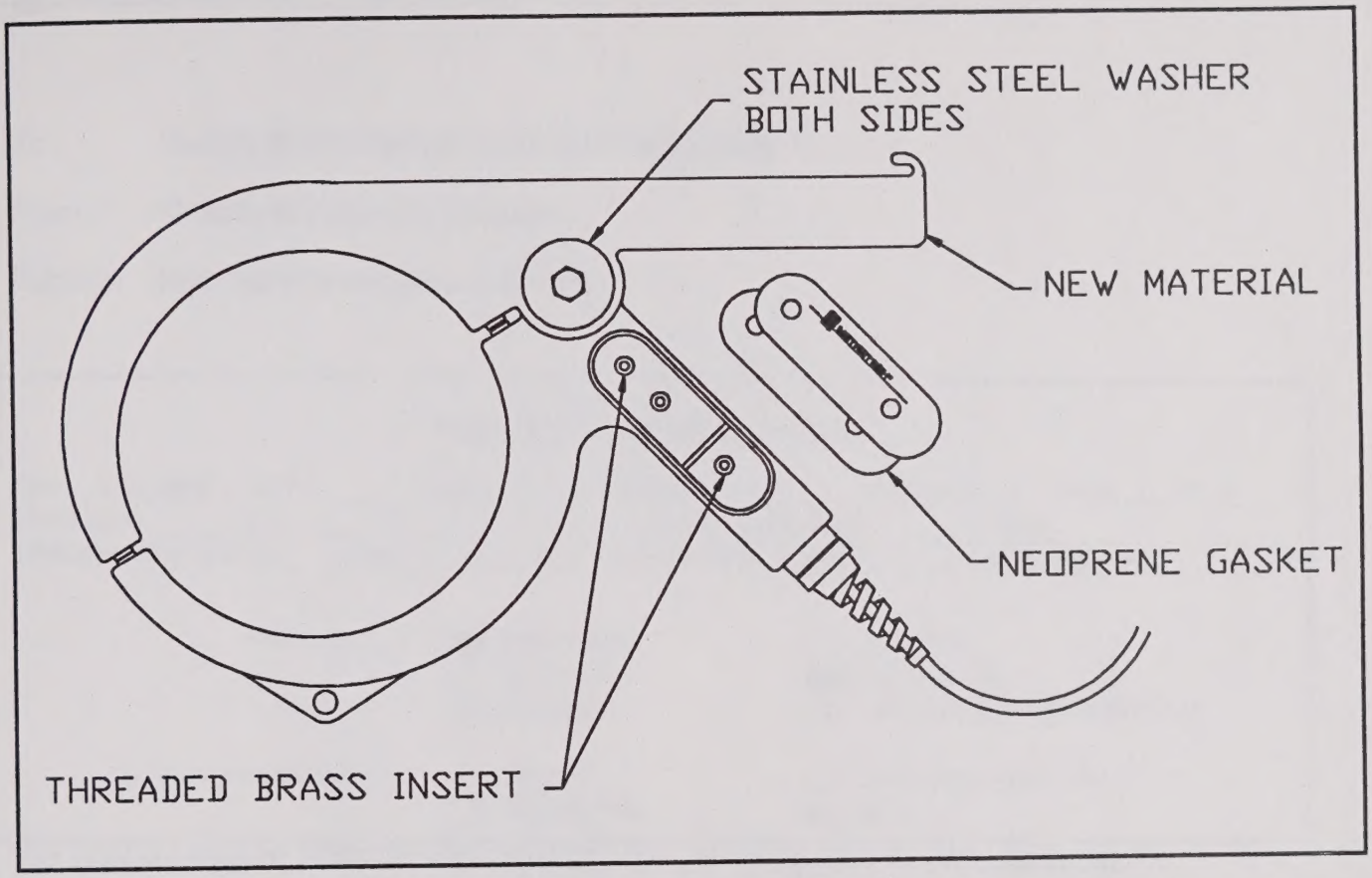
RECOMMENDED ACTION:
- ☐ URGENT
- ☐ AS REQUIRED

- ☐ NEXT MAINTENANCE CALL
- ■ NONE

Metroclamps have long been used by Model 810/850 customers for inductive coupling applications where it is not possible for a direct transmitter connection. Their rugged construction has withstood the every day outdoor use of coupling completely around any size target conductor that would fit through the jaws opening, which is somewhere near 4 inches or less in diameter. In 1987, Metrotech added cable strain reliefs to help withstand direct cable pulls by the operator.

And now, Metrotech has again directed its efforts to improving the quality of the Metroclamps construction by:

1) Changing the material composition. 2) Reinforcing the hinge area. 3) Adding threaded brass inserts and a watertight sealing gasket for easy servicing.



The new clamp shell material is called G.E. Lexan 500, which is a 15% fiberglass filled reinforced lexan with very high modulus and flexural strength. This material is approximately twice as strong as the previously used polycarbonate material and will give the clamp greater structural flexibility and strength.

Breaking of the Metroclamp at the hinge has been significantly reduced by the addition of two large washers, one on each side of the clamp. The washers prevent the hinge from twisting and help equally distribute any applied stress. This along with the new composite material will greatly strengthen this crucial pivot point.

The addition of brass inserts to the screw posts, and a watertight neoprene gasket will permit servicing personnel to easily remove the Metrotech nameplate, and gain access to the cable connections.

Metrotech is continually looking to improve the quality of our products and we believe that these added enhancements in the manufacturing of the Metroclamp will greatly intensify its durability, strength, and shock resistance. It will also provide longer product life with improved serviceability.

Steve Hallgren
Technical Support Manager

10/10/90

METROTECH

To: Models 810/610/650 Dealers and Distributors

From: Metrotech Technical Support

Subject: New Transmitter Battery Cradle

FIELD CHANGE NOTICE

FCN NUMBER *006-B* DATE *5/10/91* MODEL(S) EFFECTED 810/610/650 PAGE *1* OF *1*

ECN NUMBER *713* *SUB ASSY/ASSY EFFECTED* *400B035*

APPROXIMATE CUT-IN DATE *4/22/91* SERIAL NUMBER 810 - 23200 / 610 - 2875 / 650 - 2150

CHANGE IS:
- [x] MECHANICAL
- [ ] ELECTRICAL
- [ ] DOCUMENT
- [ ] REQUIRED
- [x] NOT REQUIRED
- [ ] NON RECOMMENDED AS RETROFIT

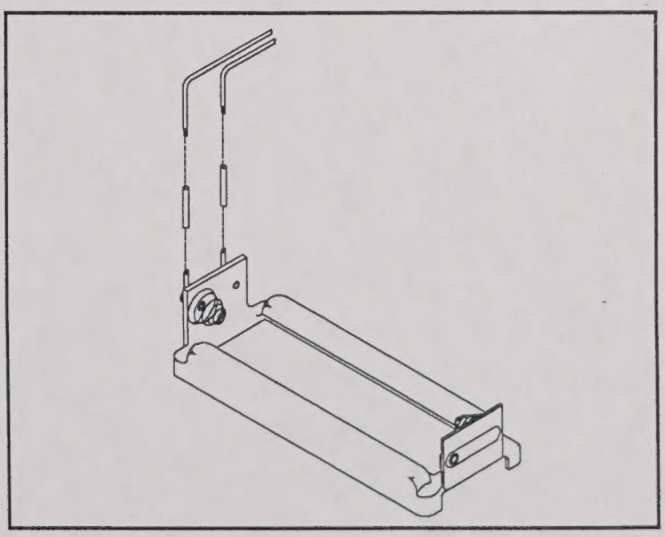
RECOMMENDED ACTION:
- [ ] URGENT
- [ ] AS REQUIRED
- [ ] NEXT MAINTENANCE CALL
- [x] NONE

This FCN supersedes FCN 006 dated April 22, 1991, to incorporate a part number change.

Keeping in tune with the current quality enhancement of improving the operators ease of removal of depleted batteries, Metrotech has just completed a redesign of the battery cradle on the Model 810, 610/650 transmitters.

The new cradle *(Part# 400C239)* is a one piece non-removable holder that allows easy insertion and removal of the transmitters' alkaline batteries. The cradle is a direct replacement for the now obsolete assembly *(Part# 400B035)* and eliminates the use of the battery tubes *(Part# 180061)*.

Steve Hallgren
Technical Support Manager
05/10/91



400C239 CRADLE